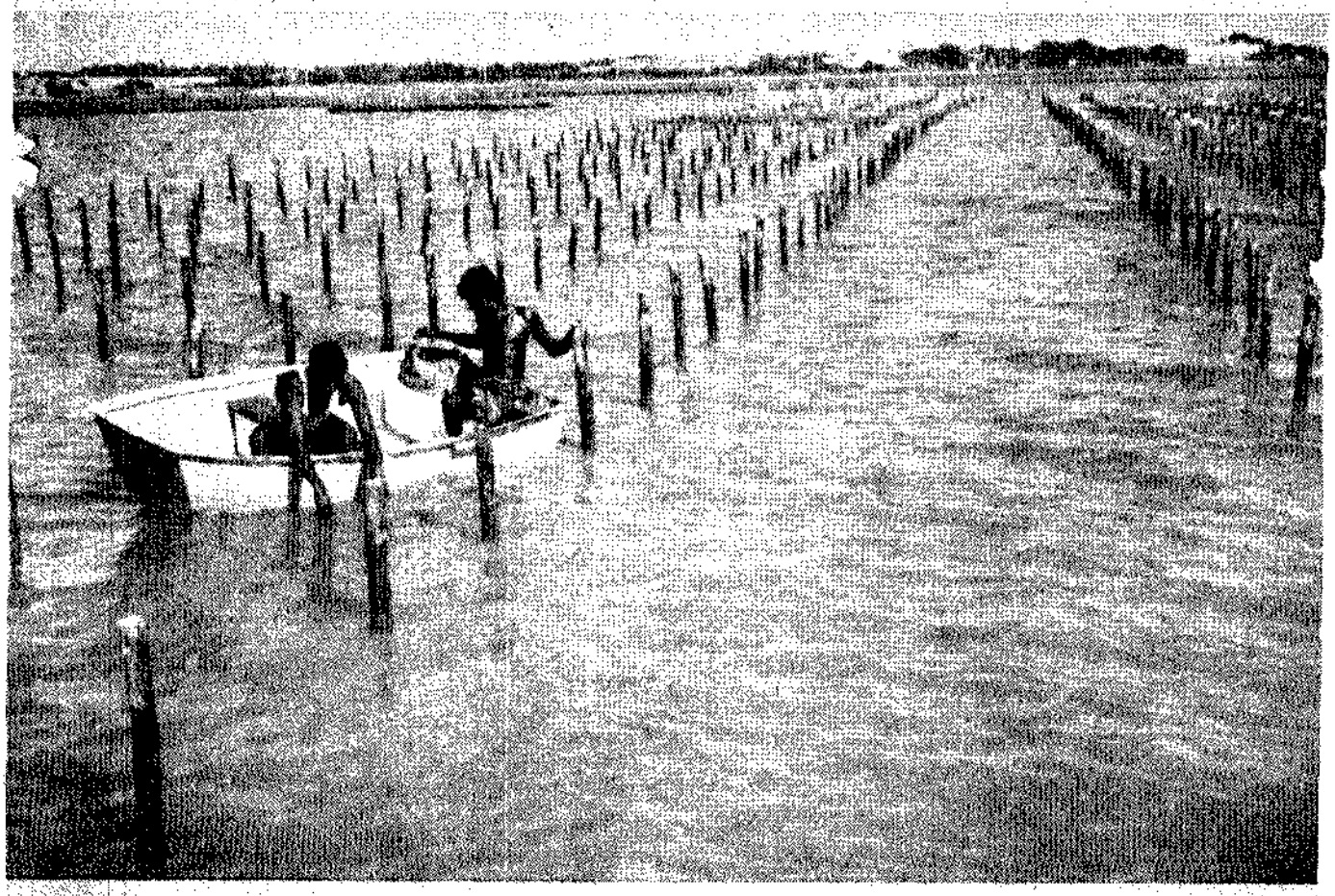
1983-84



Annual Report

1983-84

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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Cover Photo:
Edible Oyster farm at Tuticorin

DIRECTOR'S INTRODUCTION

Brief History, Organisational Set Up And Objectives

The Central Marine Fisheries Research Institute was established in 1947 by the Ministry of Agriculture and Irrigation. It was brought under the ICAR in 1967. The headquarters of the Institute is at Cochin with a Regional Centre at Mandapam Camp. Besides these the Institute has established 11 Research Centres and 29 Field Centres along the East and West coast of India. Experimental Field Stations are located at Narakkal, Kovalam/ Muttukad, Karapad, Mandapam Camp and Calicut.

The objectives of the Institute are to conduct short-term and long-term multidisciplinary researches on the marine capture and culture fisheries of the country in order to provide research support for the rational exploitation, conservation and management of the marine and salt water resources for stepping up production from the coastal waters and the Exclusive Economic Zone and development support for growth with stability of the industrial, artisanal and culture fisheries through transfer of technology, dissemination of information, education, training and extension.

The Institute has 8 major Divisions for implementing its research projects.

1. Fishery Resources Assessment Division
2. Pelagic Fisheries Division
3. Demersal Fisheries Division
4. Crustacean Fisheries Division
5. Molluscan Fisheries Division
6. Fishery Environment Management Division
7. Physiology, Nutrition and Pathology Division
8. Fishery Economics and Extension Division.

The Library and Documentation Division looks after the publications of the Institute and provides library services to the scientists.

The Centre of Advanced Studies in Mariculture funded by FAO/UNDP and ICAR and affiliated to the Cochin University is the educational wing of the Institute conducting M.Sc and Ph.D courses in Mariculture.

The Krishi Vigyan Kendra at Narakkal is the extension wing of the Institute,

imparting training to the marginal farmers in prawn and fish culture. A Trainers Training Centre in Mariculture has also been recently sanctioned by the ICAR at Narakkal.

Research Highlights

During the year 1983-84 the Institute has undertaken 129 Research Projects. Steady progress was maintained in all these projects during the year. Apart from these, good progress was also achieved in other programmes such as the Centre of Advanced Studies in Mariculture at Cochin and at the Krishi Vigyan Kendra, Narakkal. The highlights of the work are outlined below.

Marine Fish Production

The total marine fish landings in India during the year 1983-84 was estimated at 1.58 million tonnes as against 1.42 million tonnes in 1982-83 showing an increase of about 12%. The pelagic fishes formed 49.3% and the demersal fishes 50.7% of the total catch. Mechanised boats contributed 58% of the total landings while non-mechanised crafts accounted for 42%.

Stock Assessment Studies

Assessment of the catfish resources and prawn resources at some centres was completed. The analysis showed that no further increase in catch can be expected by increasing the fishing effort for prawns at Cochin and Saktikulangara.

A national training course on fish stock assessment was organised at the Institute by FAO, DANIDA and ICAR for 5 weeks during November-December 1983. Methods appropriate for estimating fish stocks in tropical seas were taught to the participants.

Pelagic Fisheries

While the oil-sardine and ribbon-fish catches declined during the year there was a marginal increase in the landings of Bombay duck, anchovies, carangids, mackerel and tunnies. Two peak periods of abundance were observed for most of the pelagic species during February-May and September-December. The Possibility of increasing production from these fisheries by increasing the fishing pressure during the periods of abundance is indicated.

Demersal Fisheries

There was an increase in the catch of catfishes, nemipterids, pomfrets, sciaenids and silver bellies during the year. Large quantities of egg-incubating catfishes were landed by the purse-seines and boat-seines at Mangalore and Cochin respectively. This mass destruction of eggs is bound to have a deleterious effect on the catfish catch in the future. The nemipterid fishery was at its peak during the south-west monsoon period when upwelling was active along the south-west coast.

Crustacean Fisheries

There was a marginal decline in the prawn landings during the year mainly due to the decline in the catch of *Parapenaeopsis stylifera* and *Metapenaeus dobsoni* along the south-west coast. However, along the east coast, higher catches were recorded in most of the centres. Recruitment of juvenile penaeid prawns in the estuarine areas was better than during the previous year in all centres except Cochin. Tagging experiments revealed that the white prawn *Penaeus indicus* is capable of travelling 630 km from Calicut on the west coast to Overi on the Tinnevely coast in 150 days.

The fishery for lobsters, crabs and stomatopods showed an improvement during the year. The north-west coast of India registered the maximum lobster landings. Karnataka and Kerala accounted for the major share of the stomatopod landings, a single species *Oratosquilla nepa* supporting the fishery. The stomatopod catch

on the east coast was poor and multispeices in character.

Molluscan Fisheries

There was a marginal increase in the cephalopod catches during the year. Maharashtra and Gujarat contributed to the bulk of the catch. The standing crop of brown mussels along the south-west coast was estimated as 1610 tonnes; about 30% of this potential was exploited during the year. A survey of the clam resources of the estuaries in Kerala and Karnataka was undertaken during the year.

Culture of Molluscs

About one tonne of edible oyster meat was harvested from the oyster farm at Tuticorin and supplied to the Integrated Fisheries Project, Cochin for canning and experimental marketing. At Muttukad lagoon near Madras pole culture of green mussel was successfully carried out. Pearl oysters grew best when suspended at a depth of 5 m. More than a lakh of pearl oyster spat were produced in the hatchery at Tuticorin. Work on induced maturation, spawning and spat production of edible oysters was successfully carried out at the Karapad laboratory, Tuticorin. Success was achieved in laboratory rearing of the larvae of the green and brown mussels to the spat stage.

Culture of Crustaceans

Further improvements were made in induced maturation and spawning of *Penaeus indicus* in captivity. The technology of large scale hatchery production of prawn seed was further simplified to reduce the cost of production. More than 4 million postlarvae of *P.indicus* was produced at the Narakkal Prawn Hatchery. About 1.7 million prawn seed were distributed free to the farmers who took up scientific prawn farming.

A major breakthrough during the year was the development of a technique for artificial insemination of the tiger prawn *P.monodon* at the Narakkal Prawn Hatchery. The present work has opened new vistas in selective breeding and genetic manipulation of penaeid prawns.

Rearing of the zoea of the green crab to the crab stage was successfully accomplished at the Karapad Laboratory, Tuticorin.

Culture of Fin Fishes

Culture of mullets and milkfish in earthen ponds at Mandapam Camp and Muttukad and in polythene film lined ponds at Calicut gave encouraging results. *Siganus canaliculatus* was induced to breed in captivity by HCG hormone injections. The fertilized eggs obtained hatched out into viable larvae.

The details of research progress in the projects of the different divisions and in the Education and Training programmes of the Centre of Advanced Studies in Mariculture and Krishi Vigyan Kendra are given in the respective chapters.

E. G. SILAS

DIRECTOR

PROGRESS OF RESEARCH

FISHERY RESOURCES ASSESSMENT DIVISION

Sample Survey for estimation of marine fish production and the effort expended (FSS/FRA/1.1)

Annual production of marine fish

The total estimated catch of exploited marine fishery resources during the year 1983-'84 along the coast of India including the Union Territories of Andamans and Lakshadweep was 1.58 million tonnes as compared to 1.42 million tonnes in 1982-'83 showing an increase of about 12%

Tables 1 and 2 show the exploited marine fishery resources of various species of fishes, prawns, lobsters and cephalopods along the Indian coast during the years 1983-'84 and 1982-'83, grouped into pelagic and demersal.

Table - 1

Annual landings of pelagic fishes (in tonnes)

	1983-'84	1982-'83
1. Clupeoids		
a) Wolf herring	16,635	14,855
b) Oil sardine	180,081	201,625
c) Other sardines	76,841	59,407
d) Hilsa shad	4,023	3,317
e) Other shads	21,256	13,297
f) Anchovies		
Coilia	18,090	15,112
Setipinna	3,382	1,784
Stolephorus	89,802	40,673
Thryssa	17,887	20,506
g) Other clupeoids	35,208	26,493
2. Bombay Duck	95,441	90,422
3. Half beaks & full beaks	2,603	2,628
4. Flying fish	1,483	1,832
5. Ribbon fishes	39,488	47,597
6. Carangids		
a) Horse mackerel	3,093	2,257
b) Scads	9,160	9,061
c) Leather-jackets	9,577	6,405
d) Other carangids	29,099	27,288
7. Mackerel		
a) Indian mackerel	33,516	24,962
b) Other mackerel	89	7
8. Seer fishes		
a) *S.commerson*	13,433	19,799
b) *S.guttatus*	21,900	13,627
c) *S.lineolatus*	286	176
d) *Acanthocybium* spp.	201	9

	1983-'84	1982-'83
9. Tunnies		
a) *E.affinis*	11,079	10,821
b) *Auxis* spp	2,596	1,953
c) *K.pelamis*	2,651	2,139
d) *T.tonggol*	11	11
e) Other tunnies	2,692	4,491
10. Bill fishes	758	2,114
11. Barracudas	3,598	3,047
12. Mullets	3,408	2,565
13. Unicorn cod	452	64
14. Miscellaneous	30,158	28,067
TOTAL :	779,977	698,412

Table - 2

Annual landings of demersal fishes (in tonnes)

	1983-'84	1982-'83
1. Elasmobranchs		
a) Sharks	39,019	39,367
b) Skates	4,066	3,779
c) Rays	27,802	21,956
2. Eels	7,707	8,132
3. Cat fishes	64,365	60,840
4. Lizard fishes	15,613	12,982
5. Perches		
a) Rock cods	2,635	2,511
b) Snappers	3,793	2,202
c) Pig-face breams	2,201	2,686
d) Threadfin breams	27,447	25,864
e) Other perches	20,426	16,763
6. Goat fishes	5,646	5,931
7. Threadfins	7,412	6,574
8. Croakers	108,572	82,170
9. Silver bellies	87,772	70,122
10. Big-jawed jumper	19,432	14,285
11. Pomfrets		
a) Black pomfret	16,524	12,878
b) Silver pomfret	40,605	35,654
c) Chinese pomfret	260	349
12. Flat fishes		
a) Halibut	1,718	1,384
b) Flounders	289	97
c) Soles	25,653	23,579
13. Crustaceans		
a) Penaeid prawns	116,619	117,467
b) Non-penaeid prawns	50,633	56,094
c) Lobsters	2,253	1,389
d) Crabs	26,461	21,000
e) Stomatopods	28,678	24,930
14. Cephalopods	18,575	15,016
15. Miscellaneous	31,058	28,806
TOTAL :	803,234	716,807
Total catch of pelagic and demersal fishes	15,83,211	14,15,219

It was seen that the pelagic and demersal groups maintain the same percentages to the total (49.3% and 50.7%) during the years 1983-84 and 1982-83. Consequently the increase in the catch of pelagic and demersal groups during the year 1983-84 as compared to 1982-83 is the same as that of the total exploited catch, the increase being 12%.

Pelagic Group Of Fishes

Oil sardine

The estimates of the exploited resources of oil sardine along the Indian coast during 1983-84 showed a minor decline of about 25,500 tonnes as compared to 1982-83, the respective figures being 1.80 and 2.02 lakh tonnes. This was due to reduced landings in the coastal belt comprising Kerala, Karnataka, Goa and South Maharashtra, the catches in the belt for the two years respectively being 1.78 and 2.00 lakh tonnes. During 1983-84, Kerala and Karnataka coasts contributed to 83.15 and 13.28% of the total oil sardine landings in the belt, the share of Goa and South Maharashtra being 2.00 and 0.49% respectively. Tamil Nadu and Pondicherry on the east coast of India also exploited oil sardine to the tune of 0.66% and 0.41% of the total catch.

Other sardines

An increase of 29.35% was noticed in the catch of other sardines during 1983-84 as compared to 1982-83, the corresponding two figures being 0.77 and 0.59 lakh tonnes respectively. Unlike oil sardine, all the maritime states of India exploit other sardines, Tamil Nadu alone accounting for 44.74% of the all India catch of "Other Sardines'. The other prominent States which contribute substantially are Andhra Pradesh (27.86%) Karnataka (9.05%), Orissa (6.36%), Kerala (6.09%) and Pondicherry (3.52%).

Bombay duck

During 1983-84, the estimate of the exploited Bombay duck resources along the Indian coast was about 0.95 lakh tonnes as compared to 0.90 lakh tonnes in 1982-83, showing a minor increase of about 5,000 tonnes. The coastal belt of Maharashtra and Gujarat contributed the bulk of the catch, the individual share of the two maritime states being, Gujarat 52.23% and Maharashtra 41.48%. West Bengal, Orissa and Andhra Pradesh on the east coast of India also exploit Bombay duck on a limited scale.

Stolephorus

The catch of *Stolephorus* during the year 1983-84 was more than double the quantity landed in 1982-83, the two estimates being 0.90 and 0.41 lakh tonnes respectively. Barring Gujarat and Lakshadweep, *Stolephorus* was exploited in the rest of the Indian coast. An estimated 62.47% of the total *Stolephorus* catch was recorded in the coast of Kerala. The coasts of Karnataka (12.81%), Tamil Nadu (11.39%) and Andhra Pradesh (10.18%) were the other major regions where comparatively good catches were recorded.

Ribbon fishes

The catch of ribbon fishes in the current year showed a decline of about 8,100 tonnes (17.03%) as compared to the last year, the corresponding estimated figures being 0.40 and 0.48 lakh tonnes respectively. The coasts of Maharashtra, Andhra Pradesh, Gujarat and Tamil Nadu recorded comparatively good catches, their individual share being 28.44, 21.55, 18.53 and 13.87% respectively.

Mackerel

An increase of about 34.27% in the exploited resources of mackerel was noticed during 1983-84 as compared to 1982-83. the estimated figures for the two years respectively being 0.34 and 0.25 lakh tonnes. The coastal belt comprising Kerala, Karnataka, Goa and South Maharashtra contributed about 0.16 lakh tonnes only, forming 47.79%, whereas the remaining 52.21% of the catch was unusually recorded from the east coast of India including Andamans. Kerala coast accounted for 79.12% of the landings on the west coast of India, the share of Karnataka being 15.43%.

Tamil Nadu contributed 45.77% of the mackerel catch from the east coast of India, the share of Andhra Pradesh, Orissa and Pondicherry being 38.44%, 9.17% and 4.65% respectively.

Oil sardine, other sardines, Bombay duck, *Stolephorus*, ribbon fishes and mackerel together contributed to 66.06% of the total pelagic catch during 1983-84.

Among the demersal group, penaeid prawns formed the major catch (1.17 lakh tonnes) accounting for 14.52% of the total demersal catch of the Indian coast during 1983-84. The important demersal fisheries were; croakers (1.09 lakh t - 13.52%), silver bellies (0.88 lakh t - 10.93%), elasmobranchs (0.71 lakh t - 8.82%), cat fishes (0.65 lakh t - 8.01%), pomfrets (0.574 lakh t - 7.15% and perches (0.57 lakh t - 6.95%). All the fishes and prawns referred to above constituted about 70% of the total demersal catch.

Penaeid prawns

The penaeid prawns are exploited by all the maritime states of India except Lakshadweep. Maharashtra contributed the maximum, forming about 31.56% of the total penaeid catch. The other maritime states which landed penaeid prawns were Kerala (22.38%), Tamil Nadu (12.89 %), Andhra Pradesh (10.38%), Gujarat (8.02%), Karnataka (5.96% and Goa (5.09%).

Croakers

Barring Lakshadweep, the croakers are exploited along the entire coast of India. The maximum landings were recorded along the Gujarat coast constituting 28.34% of the total catch of this resource along the Indian coast. Maharashtra (17.01%), Orissa (15.27%), Tamil Nadu (11.94%), Andhra Pradesh (10.84%) and Kerala (6.84%) were the other maritime states which contributed substantially.

Silver bellies

Tamil Nadu coast dominated in the large scale exploitation of silver belly resources, its share in the total catch being 69.36%. The landings from Kerala and Andhra Pradesh formed 10.46% and 7.82% respectively. The landings from the rest of the coast were poor.

Elasmobranchs

This group comprising sharks, skates and rays is exploited by all the maritime states of India. Tamil Nadu coast contributed the maximum catch (26.03%). The other maritime states which substantially exploited this fishery were Maharashtra (18.63%), Gujarat (16.60%), Kerala (13.88%) and Andhra Pradesh (13.92%).

Cat fishes

Barring Lakshadweep, cat fishes are exploited along the entire Indian coast. Kerala coast accounted for 25.05% of the total cat fish catch. Maharashtra (20.78%), Gujarat (16.42%), Karnataka (9.43%), Orissa (8.87%) and Tamil Nadu (8.28%) also contributed substantially.

Pomfrets

Pomfret resources are exploited by all the maritime states of India except Lakshadweep. The major share of the total landings was from Maharashtra (41.29%). The other states which contributed comparatively good catches were Andhra Pradesh (17.95%), Gujarat (16.24%) and West Bengal (10.80%).

Perches

The entire coast of India exploits perches throughout the year. Tamil Nadu accounted for 22.21% of the total catch of this fishery during 1983-84. Kerala (20.93%), Andhra Pradesh (15.17%), Gujarat (13.83% and Maharashtra (12.02%) were the other coasts where substantially good quantities of perches were caught.

North east region

The total catch in the north east region comprising West Bengal, Orissa, Andhra Pradesh and Andamans during 1983-84 was estimated at 250,311 tonnes as compared to 186,222 tonnes in 1982-83, showing an increase of about 64,000 tonnes. The landings of croakers, lesser sardines, pomfrets, *Stolephorus*, penaeid prawns, and non-penaeid prawns showed an increase of 17,300, 8,200, 7,600, 4,900, 4,800 and 4,400 tonnes respectively.

South east region

The region consisting of Tamil Nadu and Pondicherry coasts recorded 292,128 tonnes during 1983-84 as against 248,938 tonnes in 1982-83, showing an increase of about 43,000 tonnes. While the catch of silver bellies, lesser sardines, and elasmobranchs, increased by 16,300, 10,000 and 3,300 tonnes respectively, croakers and perches registered a decline of 3,600 and 1,400 tonnes respectively.

South west region

The south west coastal region comprising Kerala, Lakshadweep, Karnataka and Goa accounted for 536,567 tonnes during 1983-84 as compared to 516,095 tonnes during 1982-83 recording an increase of about 20,472 tonnes. The catch of *Stolephorus* and croakers increased by 42,800 and 4,400 tonnes. The landings of oil sardines and cat fishes, however, declined by 22,900 and 1,000 tonnes respectively.

North west region

The total exploited catch in the north west region showed an increase of about 34,200 tonnes in 1983-84 as compared to 1982-83, the respective figures being 498,167 and 463,964 tonnes. While the catch of croakers and pomfrets increased by 7,200 and 4,600 tonnes, non-penaeid prawns showed a decline of about 9,500 tonnes.

Landing by mechanised and non-mechanised vessels

Estimated landings by mechanised and non-mechanised crafts are given below:

	1983 - 84	1982 - 83
Mechanised	917,654	890,365
Non-mechanised	665,557	524,854
Total	1,583,211	1,415,219

Landings by mechanised crafts in 1983-84 has recorded an increase of about 27,000 tonnes while the landings by non-mechanised crafts increased by 141,000 tonnes. Mechanised landings in 1983-84 accounted for 58% of the total landings, showing a reduction compared to 63% in 1982-83. However, the contribution from non-mechanised crafts in 1983-84 accounted for 42% as against 37% in 1982-83.

All India marine fishermen census (FSS/FRA/1.2)

Data collected on marine fishermen population and infrastructure facilities through the census conducted in 1980 were analysed in detail to bring out block level consolidated reports.

Fishery Data Centre (FSS/FRA/ST. 1)

The data collected under project No. FSS/FRA/1.1 were processed and reports on the statewise and specieswise estimates of marine fish landings were prepared and disseminated to various end users.

Proformae for recording the primary data collected through the survey on marine fish landings were improved on the basis of the recommendations of the workshop on "Acquisition and dissemina-

tion of data, on marine living resources of Indian Seas" during October 1982.

Standardisation of fishing effort (FSS/FRA/1.4)

The Robson's multiplicative model (1966) which was applied to the Kakinada Trawl Fishery was applied to analyse the data on landings at Sassoon dock.

Survey of Estuarine fisheries (FSS/FRA/1.5)

A scheme for pilot studies has been formulated. There are three types of nets operated viz Dip nets, Stake nets and Free nets. For estimating resources from dip nets, broadly, the design suggested is a two stage sampling with centre day as the PSU and cluster of nets as SSU where SSU is selected systematically. In the case of Stake nets it is suggested that a 3 stage design may be tried with centre day as PSU selected at random, and row of nets as SSU selected systematically and cluster of nets as third stage unit selected systematically. In the case of free nets design similar to the one for marine fish landings survey can be tried with some variations. During the first hour of observation first 30 minutes will be used for counting the units operating and the second 30 minutes for making observation on a sample of units selected at random (SRS) and the process will be repeated during the remaining hours in the same sequence.

Exploited marine fishery resources of maritime states (FSS/FRA/1.6)

Estimates of state-wise and species-wise marine fish landings along with effort for both mechanised and non-mechanised sectors for 1981 have been published. Estimates of fish landings in respect of important fisheries harbours/mechanised landing centres have also been furnished.

Determination of Sample size for length frequency studies (FSS/FRA/1.15)

Studies were made in respect of *R.kanagurta, P.indicus, M.dobsoni* and *P.stylifera.* Minimum sample sizes for estimating mean sizes with a given margin of error of 1 mm and 2 mm were worked out for certain ranges.

Evaluation of change in the pattern of catch and composition in the artisanal and mechanised units in Tamil Nadu (FSS/FRA/1.16)

The data on fish landings in Tamil Nadu have been critically analysed to bring out the qualitative and quantitative changes in the catch composition as a result of mechanisation. In order to compare the premechanisation period with the mechanisation period the data for the years 1968, 1969, 1970, 1973, 1974, 1975 and 1980, 1981, 1982 have been studied. During this period silver bellies and penaeid prawns which are among the major fisheries in the state showed an increasing trend while *Lactarius sp* showed a decreasing trend.

Training in Fisheries Resources assessment including population dynamics (CMFRI/TR/6)

A national training course on Fish Stock assessment was organised at the Institute by FAO, DANIDA and ICAR during 7th November 1983 to 9th December 1983. Participants were drawn from organisations engaged in research and teaching in Fisheries Sciences. The objective of the training was to equip the participants with methods appropriate for estimating fish stocks in tropical seas. The course ran for 5 weeks. The first week was utilised for introducing elementary mathematics & statistics. In the remaining weeks various methods of fish stock assessment appropriate for tropical waters were discussed through case studies.

Personnel associated with the various projects of the Division

T. Jacob, K. Alagaraja, S.K. Dharmaraja, G. Venkataraman, K. Narayana Kurup, K. Balan, M. Srinath, K.S. Scariah, K. Vijayalakshmi, S.S. Dan, J.P. Karbhari, C.R. Shanmughavelu, Syed Basheerudin, G. Balakrishnan, U.K. Satyavan Varughese Philipose, K.C. Yohannan, P.K. Mahadevan Pillai, Varghese Jacob, G. Krishnankutty Nair, P. Sivaraman, V. Rajendran, V.P. Annam, P. Karunakaran Nair, Abha kant, Joseph Andrews, A. Kanakkan, S. Haja Najimudeen, C.J. Prasad, P.L. Ammini, K.P. George, M.B. Seynudeen, P.P. Pavithran, M. Ramachandra, K.Anandan, G. Subbaraman, P.T. Mani, M.R. Beena, Lata Thote, Pulin Behari Dey, Sapan Kumar Ghosh, Sukdev Bar, K.R. Somayajulu, K. Dhanaraju, V. Achutha Rao, M. Radhakrishnan, S.Satya Rao, M. Chandrasekhar, C.V. Seshagiri Rao, K. Chittibabu, K.V.S. Seshagiri Rao, P.Ananda Rao, T. Chandrasekhara Rao, A. Hanumantha Rao, G.C. Lakshmaiah, A. Agastheesa Pillai Mudaliar, M. Mohamed Sultan, H. Kather Batcha, M. Bose, S. Manivasagam, L. Chidambaram, A.Srinivasan, V. Manivasaga, L.Yeyasankaran, R.Somu, A. Thanapathi, V. Sivasamy, A. Ganapathy, P. Palani, K. Muthaiah, A. Kumar, K.Muniyandi, K.S. Krishnan, S. Sankaralingam, R. Subramaniam, C. Kasinathan, S. Subramani, O.M.M.J. Habeeb Mohamed, R. Gurusamy, K. Ramakrishnan Nair, N. Retnaswamy, I.P. Ebenezer, Jacob Jeralad Joel, R. Bhaskaran Achari, M.Babu Philip, T.G. Vijaya Warrier, S.B. Chandrangathan, V.S. Gopal A.A. Thankappan, K. Thulasidas, N. Palaniswamy, C.K. Krishnan, T. Girijavallabhan, K. Soman, T. Krishnankutty, B. Sreedhara, H.S. Mahadevawsamy, K. Chandran, Padmasekhara, Maruthy Sankar Nail, Ahamed Kamal Basha, S.B. Harikantra, Devidas Y. Naik, T.S. Balasubramaniam, A. Prosper K. Ramdoss Gandh, D.G. Jadhave, M. Shriram, J.L. Oza, K.B. Waghmare, C.J. Josekutty, Johny R. Dias, B. N. Katkar, S.D. Kamble, M. Chellappa, Y.D. Savaria, B.V. Makadia, S.S. Sugawekar, Zala Mangal Singh.

PELAGIC FISHERIES DIVISION

The major areas of research, in the Pelagic Fisheries Division, were mainly on capture fisheries carried out through 11 projects. The investigations carried out were concerned with monitoring and evaluation of resource characteristics and stock assessment of the tunas and billfishes, oil sardine, lesser sardines, mackerel, anchovies, Bombay duck, pomfrets, seer fishes and other major exploited fisheries. Good progress has been achieved under various projects during the year.

The yield from tuna, Bombay duck, anchovy, lesser sardine and carangid resources was higher during the year than the previous year. From the other resources it was lower. Two peak periods of abundance for most of the pelagic species were observed generally during February-May and September-December. Of the two, the latter was the primary peak of abundance. By increasing the fishing pressure during the periods of abundance, increased production from these fisheries could be realized.

In most of the species, two periods of spawning and recruitment were generally evident. During the current year the above pattern of spawning periodicity and recruitment of juveniles of the pelagic species was observed generally during March-May and July-September.

Resources of tunas and billfishes (FB/PR/3.1)

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Data on the resources, present trend of exploitation and biology of tunas and billfishes landed at the observation centres were collectd, analysed and studied. Among the observation centres, the highest production of 689.4 tonnes at Cochin and the lowest of 25.1 tonnes at Madras was recorded. Highest annual catch rate (250.7 kg.) was registered at Minicoy. Pole and line at Minicoy, hooks and line at Waltair and drift gill net at the other centres were the principal gear employed. Among the tunas and billfishes, landed at different observation centres, tunas contributd to 95% and the rest by billfishs. The tuna fishery was mainly sustained by *K.pelamis* (64% and *T.albacares* (15%) at Minicoy and by *E.affinis* (55.4% and *Auxis spp* (18.0%) at the other centres. The productive months for most of the tunas were generally during September-December and again during April-May.

The size composition and biology of the predominant species in the fishery were studied. *K.pelamis* and *T.albacares* ranging in size from 24 to 68 cm. and from 24 to 70 cm. respectively contributed to the fishery at Minicoy. Fishes ranging in size from 18 to 75 cm. and from 20 to 46 cm. respectively sustained the fishery for *E.affinis* and *Auxis thazard* at most of the centres. Gravid fish (stage IV-V) of *E.affinis* and *Auxis thazard* were generally observed during September-November period off the west coast of India, indicating probable breeding season for these two species.

During the year, the seasonal trend, and species composition of the tuna live-bait fishery of Minicoy was studied. The main features of the live-bait fishery was that *Athrina* spp. were used as bait in good quantities in the absence of other quality baitfishes. *Lepidozygus tapeinosoma* did not enter the Minicoy lagoon as in the previous two years. Data on the biology of *S.delicatulus, S.japonicus* and *Athrina* sp. were collected and are being analysed. Induced breeding experiments on *Chromis creruleus* were not successful.

Resource characteristics of Pomfrets (FB/PR/5.4)

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Investigations on the resource characteristics were continued at observation centres Veraval, Bombay, Karwar, Mangalore, Calicut, Cochin and Puri. Pomfret fishery was sustained by the silver and black pomfrets at West coast centres and by the former at Puri on the East coast. The fishery showed a declining trend at all the centres except at Cochin and Puri where a substantial increase in the production was observed.

During the current year the fishery registered the highest landings (1976.7 tonnes) at Bombay and the lowest (46 tonnes) at Calicut. The peak periods of abundance of pomfrets were observed generally during January-March and July-September at Veraval, July-December at Bombay and Calicut, October-December at Karwar, Mangalore and Cochin and May-June and November-January at Puri. The principal gear were drift gill net and trawl at most of the centres. However *dol* net was an important gear used at Veraval and Bombay. The Chinese pomfret, *Pampus chinensis* was occasionally caught at Karwar and Cochin trawl net.

Studies on the size distribution of the two dominant species have indicated that the white pomfret with modal sizes ranging from 120 to 250 mm at Veraval, 140 to 260 mm at Bombay, 140 to 220 mm at Karwar, 120 to 280 mm at Mangalore, 120 to 270 mm at Calicut, 110 to 270 mm at Cochin and 110 to 230 mm at Puri sustained the commercial fisheries during the year. Whereas the black pomfret with modal sizes ranging from 120 to 350 mm, 150 to 210 mm, 280 to 300 mm and from 200 to 440 mm supported the commercial fisheries at Mangalore, Karwar, Calicut and Cochin respectively. Large quantities of young ones of both the species with modal sizes ranging from 30 to 90 mm were generally caught during October-December and April-June in *dol* nets at Veraval and Bombay and in trawl nets at Karwar, Mangalore and Cochin. Among these landings, the silver pomfret, *P.argenteus* predominated.

At Mangalore and Puri females and at Calicut males of silver pomfret predominated in the commercial landings. Gravid fish (stages IV-V) formed about 30% of the landings at these places. They were, however, predominant during April-June months at Puri. The feeding activity of the species was highest during October-

December. It was found foraging mostly on salps, hydromedusae, decapod larvae, copepods and amphipods.

Studies on the distribution and abundance of spawners and young fish (FB/PR/7.1)

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Studies on the distribution and abundance of spawners and young fish based on the landings of non-selective gears, were continued at Waltair, Madras, Vizhinjam, Cochin, Mangalore and Veraval.

Young fish were abundant in the landings of indigenous gears during April-May and July-September and December at Waltair; July and August at Madras; August at Vizhinjam; April-August at Cochin and November to May at Veraval. Shrimp trawler landings of young fish were good in June at Waltair and in April and June at Cochin.

Stolephorus devisi, S. bataviensis, Rast. relliger kanagurta, Sardinella gibbosa at Waltair; *Pellona* sp., *Trichiurus lepturus, Stolephorus bataviensis, Rastrelliger kanagurta, Stolephorus devisi, Drepane punctata* and *Dussumieria acuta* at Madras; *R.kanagurta Caranx djeddaba* and *Pampus argenteus* at Cochin and *Harpodon nehereus* and *Pampus argenteus* at Veraval were the numerically abundant young fish.

The landings of dominant mature fish and spawners comprised of *Stolephorus devisi, Sardinella fimbriata, Decapterus dayi, Rastrelliger kanagurta* and *Sillago sihama* at Waltair; *Stolephours devisi, S.bataviensis* and *Thryssa dussumieria, T. mystax* and *Sardinella gibbosa* at Madras; *Stolephorus devisi* and *S.bataviensis* and *S.buccaneeri* at Vizhinjam; *Parastromateus niger, Euthynnus affinis, Auxis thazard* and *R.kanagurta* at Cochin and *Harpodon nehereus* at Veraval.

Estimation of the Fishery and Resources of oil sardine (FB/PR/9.1)

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The landings of oil sardine declined by 10% as compared to those of last year; although improvement in landings was observed in Vizhinjam, Cochin, Calicut and Karwar. This was due to reduced landings in Mangalore by about 56%. The highest annual catch rate of 1680 kg./unit day for purse seine was obtained at Cochin.

The length of oil sardine in the fishery ranged from 45 mm to 220 mm. The dominant modal groups at different centres were located at 135 mm, 145 mm, 155 mm, 165 mm, 175 mm and 195 mm. The 0 year recruits preponderated in the fishery. From the relative abundance of different age groups that sustained the oil sardine fishery at the major centres it is observed that 0-year class contributed to 59.6% and 1-year class 30.2%. However, the 1-year class was predominant, followed by 0 year class at Calicut (Table-3). Significantly the contribution of 0-year class to the fishery during the current year was lower by 27.6% compared with that of 1982 season. There was slight dominance of females. Gravid and spent adults were met within the catches of *chalavala*, drift nets, *ærhal* and *rampan*.

Table – 3

Age composition of oil sardine (nos./gear/day) in the non selective gear at different centres during the fishing season 1983-84.

Centre	Gear	Age classes			Total
		0 - year	1 - year	2 - year (+)	
Karwar	Purse seine	26172	8503	640	35315
Mangalore	Purse seine	18776	5399	1782	25957
Calicut	Pattenkolli Vala	2753	13088	3243	19084
	Nethal vala	2761	16	0	2777
Cochin	Purse seine	44280	20963	10623	75866
Total	—	94742	47969	16288	158999
%	—	59.6	30.2	10.2	100.0

Evaluation of the fishery and resource of lesser sardines (FB/PR/9.2)

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Observations on the fishery and biological characteristics were carried out at all observation centres. The landings of lesser sardines showed slight improvement over those of last year. Although a marked decline in the fishery was noticed at Karwar and Goa this was offset by improved landings at Tuticorin, Mandapam and Mangalore. Most of the catch were realised from 6–10 fathom depth range. Gill net accounted for the bulk of the lesser sardine landings. The catches were generally good during July-October and January-April. *Sardinella gibbosa* was the most dominant lesser sardine followed by *S.albella* and *S.fimbriata*.

S.fimbriata ranged from 3.0 to 19.5 cm. in total length with dominant modes located between 3.4 to 11.0 cm. for young fish. The commercial fishery, however, was contributed by size groups ranging from 10.0 to 15.5 cm. Females slightly outnumbered males. Females in advanced stages of maturity were noticed during January-March while spent fish were caught during August-November. Immature fish dominated the fishery during September-December.

S.albella ranged in size from 10.0 to 16.5 cm. with dominant modes between 12.0 to 14.5 cm. Gravid and spent fish were observed during April-May.

The size of *S.fimbriata* examined ranged from 5.0 cm. to 18.5 cm. Females slightly outnumbered males. Good numbers of spent fish were observed during October and November.

Biological observations were also carried out on *S. sindensis* (13.0 - 19.0 cm.), *S.sirm* (3.0 - 16.0 cm) and *S.dayi* (8.0-16.0 cm.). Females predominated in the case of *S.sindensis* and *S.dayi* while males of *S.sirm* outnumbered females.

Gravid and spent *S.dayi* were observed during September and November. Ripe females of *S.sirm* were caught during February and March while spent fish of this species were met with in March and April.

The fishery and resource characteristics of anchovies (FB/PR/9.3)

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Studies on the resource characteristics of anchovies were continued at all the observation centres. The anchovy fishery showed improvement in the production during the current year compared with that of previous season at most centres, except at Madras. Among anchovies that contributed to fisheries, whitebait (*Stolephorus*) contributed to about 98% of the whitebait landings and the rest by long-jaw anchovy (*Thryssa*).

The fishery for whitebait (*Stolephorus*) recorded highest production of 9807 tonnes at Mangalore and lowest (29 tonnes) at Madras. The peak periods of abundance were recorded during February-March and September-December at the West coast centres and during March-May and September-November at the East coast centres. The bulk of the whitebait catch was landed by purse seines at Mangalore and Cochin and by bag nets, gillnets and shrimp trawls at the other centres.

Stolephorus devisi in the purse seine and *S.bataviensis* in the trawl catches predominated at Mangalore. At Vizhinjam the predominant species were *S.devisi* (57.5%), *S.bataviensis* (33.9%) and *S.bucaneer* (7.8%) in the whitebait landings by the artisanal gear. Contributing to about 60% and 39 % respectively both *S.bataviensis* and *S.devisi* supported the trawl catches at Madras. A similar trend in the species dominance was observed at Waltair centre.

S.devisi having dominant sizes at 45-65 mm and 75-85 mm and *S.bataviensis* at 50-60 mm and 80-95 mm sustained the fishery at all the centres. Early juveniles of both the species were observed in June at Mangalore, February-March and June-August at Vizhinjam January-March at Madras and April-May at Waltair.

In the catches males outnumbered females at Mangalore, were found in equal proportion at Vizhinjam and Waltair and females predominanted at Madras. Gravid fish were observed predominantly during March-May and October-December for both species at most of the observation centres.

Evaluation of the fishery and resource of mackerel (FB/PR/9.4)

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Investigations on the fishery and resource characteristics of mackerel were carried out at all observation centres. There was a general decline in the landings of mackerel as compared to those of last year. The catches declined by 26% in Karwar, 60% in Mangalore, 65% in Calicut and 28% in Cochin while three fold increase, from 72 mt in 1982-83 to 241 mt. in 1983-84, was noticed in the mackerel landing at Vizhinjam. The landings of the indigenous gears at Mandapam Camp and Waltair slightly declined in 1983-84. However, shrimp trawl landings at Waltair showed good improvement. The bulk of the purse seine landings were taken from 11-20 fathom area while good catches were taken by the trawl nets from 6-10 fathom region.

The sizes of mackerel landed ranged from 210-260 mm at Karwar, 153-260 mm at Calicut, 95-285 mm at Vizhinjam and 65-245 at Waltair. Recruitment to the fishery was noticed during April-June and August-October period. Gravid fish were observed in the catches from March-August and spent fish till October. Majority of the fish were immature during April-June period. The 0 and 1 year classes dominated the fishery.

Evaluation of the fishery and resources of seerfishes (FB/PR/9.5)

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During the year under report, investigations on the fishery and resources of seerfishes were conducted at Mangalore Calicut, Cochin, Vizhinjam and Waltair.

At Mangalore with an estimated catch of 853 tonnes during the year the fishery showed a decline of 20% in production as compared with the previous year. Drift gill net was the principal gear employed. The highest catch and catch rate was observed during October-December. The fishery was mainly supported by *Scomberomorus commerson* (84.5%) and by *S.guttatus* (15.5%). The peak abundance of both the species was recorded during November. The fishery was mainly supported by sizes ranging from 475 to 875 mm in the case of *S.commerson* and from 375 to 455 mm in the case of *S.guttatus*.

The seerfish fishery at Calicut yielded an estimated catch of 73 tonnes. Drift gill net was the principal gear and accounted for 99% of the total production. Off this coast the peak abundance for the resource was observed during October-December. *S.commerson* was the predominant species (99.3%). The species with dominant size ranging from 625 to 700 mm contributed to the fishery. The recruitment of younger fish, measuring 250-400 mm was observed in September.

The fishery with an estimated catch of 437 tonnes during the current year showed a marginal increase in the production at Cochin as compared with previous year. Similarly catch rates were better during the current year. Drift gill net was the main gear employed in the fishery. The peak abundance of the resource was observed during October-December. The bulk of the year's landings was supported by *S.commerson* (98.9%). The peak fishery was supported by the fishes ranging in size from 525 to 975 mm. *S.guttatus* with dominant sizes from 325 to 425 mm was recorded in the catches.

At Vizhinjam the fishery for seerfishes showed significant increase in production during the year with an estimated catch of 223 tonnes as compared with 68 tonnes during the previous season. Drift gill nets accounted for 98.2% of the total landings. Maximum catch and catch rate were recorded during September-October. The predominant species was *S.commerson* followed by *S.guttatus*.

The seerfish fishery during the year under report has yielded an estimated catch of 167 tonnes of which about 148 tonnes were landed at Lawson's Bay landing centre and the rest at the Outer Harbour. At both the centres hook and line and drift gill nets accounted for the bulk (87.5%) of the landings. The most dominant species that contributed to the fishery was *S.guttatus* (57.2%) and the rest by *S.commerson*. The maximum catch and catch rates were recorded during August-November. Both *S.guttatus* and *S.commerson* measuring less than 400 mm were seldom caught by hooks line and bottom set gill nets.

Evaluation of the fishery and resources of Bombay duck (FB/PRP 9.6)

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Bombay duck investigations were continued at Veraval in Sourashtra coast and at Bombay in Maharashtra coast. At Veraval the fishery marginally declined, as compared to that of last year, with an estimated present catch of 12,307 tonnes. At Bombay the fishery, however, showed a significant increase in production during

the current year with an estimated catch of 4,898 tonnes of which 42.2% at Versova, 29.1% at Arnala and 28.7% at Pochubunder were landed. Dol net was the principal gear employed in the fishery along the Sourashtra and Maharashtra coast. Maximum abundance of the species was observed during December at Rajapara (Veraval) during November at Arnala, October at Versova and during September at Pachubunder centres of Bombay coast.

The size of the Bombay duck ranged from 30 to 345 mm. at Veraval; while it varied from 30 to 390 mm. at Bombay. Young fish of the sizes 30-40 mm. and 60-70 mm. were abundant in November, February and March at Veraval. The fishery at Veraval was dominated by 0-year class, while I and II year classes comprised the bulk of the landings at Bombay.

In the landings male and female fish were represented in equal proportion at Veraval, while females predominated the catches at Bombay. While gravid and spawning fish were found predominant generally during April-July, spent ones dominated the landings during October-December at all the observation centres along Sourashtra and Maharashtra coast.

Experimental fishing conducted at Bombay with the conventional *dol* net (cod-end; 15 mm mesh) and CIFT-designed *dol* nets (code-end; 30 mm and 40 mm mesh) showed that the catch of Bombay duck comprised 22.82%, 15.1% and 9.8% respectively. In these three types of experimental nets, the size of the species ranged from 15 to 245 mm, 45 to 345 mm and 75 to 380 mm respectively. Similarly the percentage of fish caught below 150 mm size were in the order of 20.8, 12.7 and 5.00 in the above three types of nets.

Evaluation of the fishery and resources of Carangids (FB/PR/9.7)

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Investigations on the fishery and resources of carangids were continued at all the observation centres. The fishery showed considerable improvement in 1983-84 as compared to the previous season.

Carangids landed by the indigenous gears at Lawson's Bay and Outer Harbour and by shrimp trawlers at the Fishing Harbour at Waltair totalled 415 tonnes which is an improvement of 59% over that of last years landings. Off Waltair coast the peak abundance was generally recorded during February-May and September-October. *Decapterus dayi* dominated in the landings of shrimp trawlers (86.7%) and boat seines (99.3%). While *Megalaspis cordyla* constituted the bulk of the hooks and line (78%) and bottom set gill net (56%) catch, *Selar crumenopthalmus* predominated in the landings of shore-seine (59%) and bottom set gill net (56%). The biology of *M.cordyla* and *D.dayi* was studied. In the former species, fishes belonging to 1-year class supported the fishery. Recruitment of young ones was observed during June-October. In the later species, fishes of 0-year and 1-year class sustained the fishery. In both cases males were dominant and males appear to spawn earlier than females. Fishes in partially spent and fully spent condition dominated the catches. *D.dayi* was found feeding mainly on *Acetes*, euphausids and pelagic tunicates; while *M.cordyla* were mainly feeding on *Squilla, Acetes* and *Stolephorus*.

The fishery at Mandapam yielded an estimated catch of 84 tonnes of which 96.4% were caught by shrimp trawl and the rest by shore seine. *Selar leptolepis* predominated the fishery. Fishes ranging in size from 40 to 165 mm supported the

fishery. The species was found to grow at the rate of 4 mm per month and attain a size of 127 mm from 92 mm in about 9 months.

With estimated landings of 1504 tonnes, the fishery at Vizhinjam showed a spectacular improvement in the current year which is about twice that of the previous season's. Off this coast maximum abundance was observed during June-October. Hooks and line accounted for the bulk (54.2%) of the landings followed by boat-seines (9.2%). Maximum production (74.1%) was confined to the depth range of 20-30 fathoms; while rest of the catches came from 5-20 fathoms depth. *Decapterus dayi* was the predominant (71.1%) species. Recruitment of the species to the fishery was observed in February having a modal size at 142 mm. First-year class dominated the fishery throughout the fishing season. *Selar mate* ranging in size from 100 to 260 mm were observed in the catches. Recruitment of the species to the fishery was observed from January onwards. In both species sexes were equal. Gravid fish of *D.dayi* and maturing fish of *S.mate* dominated the landings. The former species was found feeding on *Lucifer*, *Acetes*, copepods and fish larvae.

The carangid landings at Cochin was estimated at 715 tonnes during the current year showing considerable improvement over the previous season. Purse seines landed 54.7% and drift gill nets 27.6% of the total carangids. Peak abundance for this resource was recorded during September-November. *Alepes djeddaba* (99.7%) in the purse seine landings; *Scomberoides commersonianus* (76.1%) and *A.djeddaba* (18.2%) in drift net landings predominated. *A.djeddaba* ranging in size from 115 to 345 mm and *A.kalla* ranging in size from 60 to 130 mm contributed to the fisheries. In both the species gravid fishes were predominant during October-December. Juvenile anchovies and amphipods were important food items of *A.kalla*, while whitebait, silverbellies, *Cavolina* and *Lucifer* were common food items of *A.djeddaba*.

With an estimated production of 651 tonnes at Mangalore the carangid fishery showed a decline of 11% during the current season compared to that of previous season. The bulk of the catch (54.5%) was landed by purse seines. Peak period of abundance was observed during May-June. Predominant species that sustained the fishery were *Caranx kalla* (54.5%), *Megalaspis cordyla* (23.6%) and *Selar mate* (19.0%). Optimum depth zones for fishing these resources by purse seine and trawl appear to be 11-20 fathoms and 6-10 fathoms respectively. *C.kalla* ranging in size from 65 to 150 mm contributed to the fishery. Recruitment of young fish to the fishery was observed during October and January. Indeterminate and immature fish were dominant in the fishery.

An estimated 379 tonnes of carangids were landed at Veraval. Peak abundance at this centre was observed during September-March. *Caranx* sp. (39.5%), *D.russelli* (27.2%) and *Chorinemus* (16.0%) in the trawl landings; *M.cordyla* (50.6%) and *Chorinemus* sp. (42.5%) in the drift gill net catches predominated. The size of *M.cordyla* in the fishery ranged from 225 mm to 449 mm.

Evaluation of major pelagic fish resources (FB/PR/9.9)

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The data on the exploited pelagic fish resources landed by the artisanal and mechanized fisheries at the observation

centres was collected, analysed and studied for the seasonal distribution and abundance of the dominant pelagic species.

An estimated catch of 20,294 tonnes of pelagic fishes was landed at Veraval mainly by trawls (85.9%) and by drift gill nets (14.1%). Among the pelagic fish resources off this coast, the most dominant species in the order of abundance were big-jawed jumper (32.7%), ribbon fishes (16.0%), anchovies (12.6%), squids (6.5%), wolf-herring (4.5%), *Hilsa* spp. (4.0%), *Ilisha filigera* (3.2%) seerfishes (2.9%), sharks (2.5%) and pomfrets (1.9%). The maximum abundance was generally observed during February-May and September-December for most species.

At Bombay (Sasoon docks & New Ferry Wharf) an estimated catch of 8505 tonnes of pelagic species was landed by trawl. Of this total, about 72.4% landed at Sasoon docks and the rest at the New Ferry Wharf. Highest catch and catch rates were generally observed during April-June and September-November. The predominant resources that contributed to the fisheries off this coast were clupeids (33.8%), ribbon fishes (27.7%), tunas (14.3%) carangids (13.4%) and silver pomfret (10.7%) in the order of abundance. Along this coast the maximum concentration of clupeids during April-June and September-December, ribbonfishes during April-May and August-November, Carangids during February-May and September-December, tunas during January-March and September-November and silver pomfret during February-May and September-November were observed.

The pelagic resources off the Mangalore coast were exploited by the purse seine and drift gill net fisheries. The estimated annual catch was 18,210 tonnes of which purse seines contributed to about 98% and the rest by the drift gill nets. The dominant species that sustained the purse seine fisheries were oil sardine (44.6%), anchovies (23.4%), lesser sardines (9.2%) and mackerel (6.6%); and the drift net fisheries were seerfishes (45.3%), sharks (28.2%) and pomfrets (4.3%). Two peak periods of abundance during January-March and September-November were generally observed for most of the species. Of the two peaks of abundance, the September-November peak was the predominant one.

Off Calicut the artisanal fishery landed an estimated catch of 4198 tonnes of pelagic fish by bagnets (96.5%) and by drift gill nets (3.5%). The predominant species that contributed to the pelagic fisheries at this centre were oil sardine (95.1%), seerfishes (1.7%), mackerel (1.3%) and pomfret (1.1%). For most of these species maximum abundance was generally observed during September-November.

The pelagic fisheries at Cochin landed an estimated catch of about 13,024 tonnes; out of which purse seine accounted for 90.8% and drift gill net 9.2%. Off this coast the dominant pelagic species that sustained the fisheries were the oil sardine (81.0%), mackerel (9.7%) tunas (4.8%) and seerfishes (3.0%). During the current year the period of abundance was observed during April-July and September-November for most of the species.

The artisanal fishery at Vizhinjam, during the current year, landed an estimated catch of 5118 tonnes of pelagic fish forming 78.2% of the total fish production. Several types of fishing gears were employed. However, the bulk of the pelagic fish were caught by boat seines (36.1%), hooks and line (29.9%), drift nets (19.2%) and by *chalavala* (7.9%). Anchovies ranked foremost constituting 29.6% of the total pelagic fish landings, followed by carangids (29.3%), tunas(11.0%), lesser sardines (5.1%), mackerel (4.7%), seerfishes (4.3%), ribbonfishes (2.9%), oil sardine (2.9%) and rainbow sardines (2.8%).

Along this coast the peak periods of abundance for anchovies, rainbow sardines and ribbonfishes were observed during June-August and the carangids, tunas, lesser sardines, rainbow sardines, oil sardine, seerfishes and mackerel during March-May and September-November.

During the current year an estimated 77.4 tonnes of pelagic fish from the Gulf of Mannar were landed by drift gill nets (140 mm mesh) at Keerakati (Mandapam Camp). Seerfishes, tunas, *Chorinemus* and sharks were predominant components in the pelagic landings. For most of these species two peaks of abundance during January-April and September-December were observed. At the above centre drift gill nets (60 mm mesh) landed an estimates catch of 112.7 tonnes. The major components in these landings were mackerel, *Hilsa kelee*, wolf herring, seerfishes and *Caranx* sp. The peak abundance for mackerel was recorded during April and December, for *Hilsa* sp. during April: for seerfishes during August-September and December; and for carangids during the months of April and June. At 'Valai Theevu' and Ervadi centres, on the Gulf of Mannar coast an estimated catch of about 54 tonnes of juvenile sardines were landed during October 1983 by 90 shore seines. The major component species were *Sardinella longiceps* (80%) and *S.gibbosa* (19%). From the Palk Bay centre an estimated 3502 tonnes and 23 tonnes of lesser sardine were landed by small meshed gill nets (30 mm mesh) and by shore seines respectively. In both cases *S. albella* constituted about 65% of the lesser sardine landings. The peak abundance of this resource in the area was observed during May-August.

At Madras an estimated 599 tonnes of pelagic fish were landed mainly by gill nets (55.6%), bag nets (38.4%) and hooks and line (6.0%). In the pelagic fish resources of this coast the dominant species that contributed to the catches in the order of abundance were *Sardinella* spp. (29.1%), seerfishes (16.1%), mackerel (11.7%), and carangids (7.1%). For most of the above species two peak periods of abundance during February-April and June-September were observed.

The pelagic fish landings with an estimated catch of 2,557 tonnes formed 26.8% of the total fish production at Waltair. The bulk of the pelagic fish species at Lawson's Bay landed by hooks and line (52.5%) and bottom set gill nets (23.0%); and at Outer Harbour by gill nets (49.4%) and by boat seines (25.2%) and by shrimp trawlers (19%) at the fisheries harbour. The major components of the pelagic landings were ribbonfish (13.3%), *Sardinella* spp. (9.9%), carangids (9.3%), mackerel (7.8%), seerfishes (7.0%) and anchovies (4.8%). For the predominant pelagic species off Waltair two peak periods of abundance during January-April and June-August were observed.

DEMERSAL FISHERIES DIVISION

Estimation of the stocks of catfishes (FB/DR/1.8.1)

B. KRISHNAMOORTHY, Y. APPANNA SASTRY, V.N. BANDE, N. GOPINATHA MENON, C. MUTHIAH J.C. GNANAMUTHU AND S.G. RAJE.

Mangalore: During the year 1983-84 the cat fish landings were 1815 t against 5538 t in the previous year. The decrease was mainly on account of poor catches in the purse seiners, which landed 4444 t in 1982-83 as against 1028 t in the current year. The trawl catches have also registered a decline in this year, but the gill net catches showed a marginal increase.

In the purse seine fishery, *T.dussumieri* accounted for 68% and rest by *T.tenuispinis*. In the gill net also *T.dussumieri* was the major constituent, 42%, followed by *T.serratus* 40%, *T.tenuispinis* 16% and *T.thalassinus* 2%. In the trawl catch *T.tenuispinis* was a major catch (85%) followed by *T.thalassinus* (12%) and *T.dussumieri* (3%).

During October, the purse seiners netted incubating males of *T.tenuispinis* causing destruction of about 17 lakhs of eggs (55 lakhs of eggs in the previous year).

About 88% trawl catch was that of young *T.tenuispinis* in the size range 40-109 mm during February-May.

Because of the large-scale destruction of eggs by purse seiners in the previous years the catch of this species has been affected very much.

Calicut: An estimated catch of 670.7 t cat fish landed at Calicut during the year 1983-84. Hooks and line constituted the major catch (321.2 t). The entire catch of trawl net and *pattenkolli vala* was that of *T.tenuispinis*. All the four species were represented in hooks and line catch. There was an unprecedented catch of *T.tenuispinis* (302 t) from 21.10.83 to 26.10.83 by *Pattenkolli vala* from the 30-35 m depth zone.

From September to November, 90% of the hooks and line catch consisted of spent females and the rest by spent males. The entire *Pattenkolli vala* catch in October was of gestating males of *T.tenuispinis* with eggs/embryos in their buccal cavity.

A study on the depth-wise distribution of cat fish catches by hooks and line showed that *T.tenuispinis* and *T.thalassinus* were abundant in depths 30-60 m., while *T.dussumieri* and *T.serratus* were common in shallow depth with rocky bottom.

Cochin: An estimated catch of 503.76 t cat fish was landed in Cochin Fisheries Harbour during 1983-84, showing 11% increase over the previous year (453 t), mainly due to five-fold increase in the trawl landings comprising exclusively *T.tenuispinis* (156 t). Drift net catches contributed 49% only as against 83% in the previous year. The trawl catch formed 44% and the purse seine contribution was only 6.5%.

Species-wise, *T.tenuispinis* contributed 31.49%, followed by *T.serratus* 27.03%, *T.dussumieri* 24.22% and *T.thalassinus* 17.26%.

An observation worth mentioning is that during last 3 years the females of *T.tenuispinis* and *T.thalassinus* beyond the maturity stage IV are not available in Cochin waters. Huge catches of egg incubating males of *T.tenuispinis* are reported to have been landed by purse seiners in the Karnataka region. Possibility of the breeding grounds of these species in the Karnataka coast is not ruled out and requires further investigation.

Watlair: An estimated catch of 166.38 t cat-fish was landed at Waltair, during the year. Trawlers contributed the major share (140.74 t) followed by hooks and line (23.66 t) and the rest by bottom-set gill net.

In trawl net 96% of the catch was that of *T.thalassinus* and the rest *T.tenuispinis*. July-December was the good season on Visakhapatnam coast.

Males and females were almost equal in number. Females in spent condition were observed in May and December. Stomatopods, molluscs, crabs, fish and squids were the chief items of food.

Resource characteristics of perches (FB/DR/1.8.2)

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During the year perch fishery was monitored at Bombay, Vizhinjam, Tuticorin and Mandapam. At Bombay trawl nets were used in the perch fishery. A total 1045.5 tonnes of perch were landed at Bombay. This formed 2.67% of the total fish landed there. Altogether 25261 trawl net units were operated at New Ferry Wharf. At the Sassoon Dock landing centre at Bombay 20324 trawl net units landed 103.32 tonnes of perch. This formed 0.27% of the total fish landed there during the year. *Lutianus johnii Priacanthus* spp., *Pomadasys maculatus*, *Serranus diacanthus* were the important species of perch landed at Bombay.

There were good perch landings at Vizhinjam during the year. Total perch catch by commercial craft operated at Vizhinjam came to 476.2 tonnes. Over 68.8% of the perch landed at Vizhinjam were caught by hooks and line. Next important gear was boat seine. Other gear that landed perch during the year include drift net, shore seine, *konchu vala* and *achil*. Also mechanised vessels operating hooks and line and drift nets landed perches at Vizhinjam. *Nemipteridae*, *Theraponidae*, *Siganidae*, *Lutjanidae*, *Priacanthidae*, *Lethrinidae*, *Serranidae*, *Ambassidae* were the important families represented in the catches. Good perch landings were recorded between July to September with the peak landings in August. The catch-per-unit fluctuated considerably from gear to gear as also from month to month.

Perch fishery at Tuticorin was monitored from Tuticorin landing centres and Tharuvaikulam landing centres. A total of 421.9 tonnes of perch was landed. Drift net, hooks and line, gill net and shore

seine (*olai valai*) were employed in the perch fishery. At Tuticorin hooks and line was the important gear for perch and drift nets came second. Good quantities of small-sized perch were caught at Tharuvaikulam using *olai valai*. A total of 5.46 tonnes of small perches were landed by *olai valai*. Good perch landings were noticed during September at Tuticorin.

Lates calcarifer, Lethrinus, Serranus, Lutjanus, Diagramma were the important species that contributed to the perch fishery at Tuticorin. Studies were made on the size composition of *Lethrinus nebulosus*. Fish from 4.0 cm. to 74.0 cm. were observed in the commercial fishery. Small fish from 4.0 cm. to 27.0 cm. were landed by shore seine, while the larger specimens were observed in the drift net and hooks and line samples.

Most of the fishery for perch at Mandapam were conducted at Kilakkarai where perch traps and hooks and line were employed. Of the total annual catch of 21.82 tonnes, 17.0 tonnes were landed by perch traps and 4.78 tonnes by hooks and line. *Lethrinus nebulosus, Lutjanus, Epinephielus, Siganus* and *Plectorhynchus* were the important species landed at Kilakkarai. By perch traps *Lethrinus nebulosus* from 9.0 cm. to 24.0 cm. were caught with dominant size group at 14.0 cm. Hooks and line samples contained *Lethrinus nebulosus* from 11.0 cm. to 41.0 cm. with the mode at 15.0 cm. All the fish observed were immature and gut-content contained mostly crab remnants.

Resource characteristics of threadfin breams (FB/DR/1.8.3)

V. Sriramachandra Murty, E. Vivekanandan, K.V. Somasekharan Nair, Grace Mathew, S.K. Chakraborty And S.G. Raje.

I. *Fisheries:* At Waltair, the private trawlers landed an estimated 1451 tonnes of threadfin breams which formed 17.2% of total trawl catch. Peak catches and catch rates were obtained during April, May, December and March. The threadfin bream landings registered an increase of 197% over previous year along with an increase of 53% in the trawling time.

At Kakinada an estimated 1090 tonnes of nemipterids were landed by the commercial trawlers which formed 5.2% of total trawl catch. Peak catches and catch rates were obtained during January-March period; the catches during these three months together accounted for 60% of the nemipterids landed during the period under report. The catches showed only 7% increase over previous year along with an increase of 21% in the effort.

The trawlers at the Kasimedu landing centre (Madras) landed an estimated 927 tonnes of threadfin breams which formed 11.4% of total trawl catches. Peak returns were obtained during June-September period, the catches during these four months accounting for 53% of these fishes landed during the year. When compared to the previous year the catches showed only slight (2%) decline.

The trawlers at the Fisheries Harbour at Cochin have landed an estimated 1019 tonnes of threadfin breams with an average catch of 21 kg. per unit. Maximum catches were obtained during July-August 1983, the catch during these two months forming about 76% of total nemipterid catch obtained during the year under report. Maximum catch rates of 76 and 90 kg. per boat were obtained during these months respectively. The nemipterid catch showed a considerable decline of 73% over previous year though there was only 3% decline in the effort. This decline in the catch is mainly due to diversion of effort for catching prawns during monsoon months also.

At Calicut the private trawlers landed an estimated 45 tonnes of threadfin breams

with an average catch of 14.4 kg. per boat. These fishes occurred in the catches during 5 months only, April-May 1983 and January-March 1984, though there was fishing by trawlers for 8 months.

At the two landing centres, Sasoon Docks and New Ferry Wharf, at Bombay, an estimated 3003 tonnes of nemipterids were landed which formed 4% of total catch by private trawlers. Comparatively better catches were obtained during April-May and October-November. When compared to the previous year the catches of nemipterids showed a decline of 31% though the effort expended was more or less the same. During the previous year, the landings at New Ferry Wharf were much less than at Sassoon Docks though the effort at these two landing centres was comparable, whereas during the year under report, the landings at these two centres were 1564 and 1439 tonnes resspectively with a corresponding effort of 20561 and 20324 units.

At Veraval the estimated landings of nemipterids were 914 tonnes during April-May and October-December periods; there was no fishing during June-September due to monsoon.

Five species contributed to the fishery at Waltair, Kakinada and Madras, whereas two species contributed to the fishery at Cochin, Veraval and Bombay and only one species at Calicut. Of the five species, *N.japonicus* and *N.mesoprion* were abundant: at Waltair, *N.mesoprion* formed 78% of threadfin breams whereas *N.japonicus* formed 18%. At Kakinada also *N.mesoprion* was dominant but formed 48% of nemipterid catches while *N.japonicus* formed 42%. At Madras about 58% of nemipterid catches belonged to *N.japonicus* and *N.mesoprion* formed only 9.4%. At Cochin *N.japonicus* formed 61.5% of nemipterid catches followed by *N.mesoprion* (38.4%). At Veraval *N.japonicus* and *N.mesoprion* contributed to 74.4% and 25.6% of nemipterid catches respectively.

II. *Biology of N.japonicus:* At Waltair, the length range of the catch was 65-295 mm, at Kakinada and Madras 55-285 mm., at Cochin 65-265 mm, at Calicut 75-155 mm, at Bombay 95-255 mm, and at Veraval 45-295 mm. The annual length composition of catch shows that excepting Calicut, the length range of catch is more or less same at different centres.

At Waltair the smallest modal length in the catch was 65 mm in November, at Kakinada the smallest modal length recorded was 65 mm in February, at Madras the same was 75 mm in March. The smallest modal length recorded was 85 mm in December at Cochin and 65 mm in December at Veraval.

At Kakinada, males outnumbered females in all months except January. Gravid adults occurred during April, September and December-February with peak during December-February. At Madras, mature and spent adults occurred in almost all months whereas gravid individuals occurred in small numbers in July, December and February. At Cochin, gravid adults occurred in considerable numbers during July, August and November. At Veraval, gravid adults occurred in considerable numbers during October-February.

Assessment of Sciaenid resources (EB/DR/1.8.4)

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Waltair: From the centre an estimated total catch of 638 tonnes of sciaenids, which formed 7.6% of total fish catches was landed from private mechanised trawlers.

Maximum catches were realised during the period of November-December 1983.

From Fishery Survey of India trawlers, namely from 'Matsyashikari" and "Matsyadarshini" 3822 kg. of sciaenids were realised.

J.carutta, J.volgleri, N.maculata, K.axillaris were the important species of sciaenids that contributed to the fishery.

Kakinada: From the private trawlers operated from Kakinada an estimated catch of 1362 tonnes of sciaenids was realised. Peak catches, together with high catch rates, were obtained in May, July and September-November. When compared to last year the catches increased by 135% with increase in effort of 19.3%.

Atrobucca nibe, N.maculata, Johnius carutta and *J.vogleri* were the dominant species. *J.carutta* ranged in size from 75-255 mm. Young fishes measuring 125 mm formed a mode in July and August. Mature fish occurred in May '83 and January-March '84. In majority of fishes stomachs are in everted condition.

Madras: During this year from Kasimode fish landing centre an estimated catch of 547 tonnes of sciaenids was landed which formed 6.8% of total catches. Peak catches together with peak catch rates were obtained in March '84 and November '83 respectively. Further, the catches increased by nearly 100% when compared to last year's.

Out of 15 species that contributed to the fishery *Johnius carutta, Otolithes argenteus, Kathala axillaris* and *Pennahia aneus* were important.

Biological studies were made on *J.carutta* and *K.axillaris. J.carutta* measuring 90-109 mm and 160-169 mm were dominant in the catches. Females with ripe ovaries were observed during April, June and October. Squilla formed the major component of the food of this species. *K.axillaris* measuring 120-149 mm were dominant in catches. Fishes with ripe gonads were noticed during May-July. Squilla and prawn constituted the major food of this species.

Bombay: At New Ferry Wharf an estimated catch of 2446.36 tonnes of sciaenids was landed contributing 6% of total catches. The fishery was good during the period October '83 to March '84. The percentage of sciaenids was maximum during July '83.

At the Sassoon Docks about 1439.9 tonnes of sciaenids were landed by the trawlers. Peak catches together with peak C.P.H. were recorded in January and February '84. This corresponded with high percentage contribution of sciaenids during the month of December '83 and January '84.

Biological studies were carried out on *J.macrorhyncus* and *O.cuvieri* and *J.vogleri* with reference to length frequency distribution and catch per unit effort in number in different months.

Studies on sex ratio in *J.macrorhyncus* and *O.cuvieri* showed that the percentage of males was more than that of the females, while in *J.vogleri* the sex ratio was equal. In almost in all the species maturing individuals dominated in the catches. Mature females of *J.macrorhyncus* occurred in January and February, while for *O.cuvieri* in April and May '85; for *J.vogleri* April '83 - May '83 and August '83 - September '83 and January '84 - February '84.

Veraval: From this centre catches were landed by trawlers and gillnetters operated by In-board and Out-board motors. From the trawlers and gill nets an estimated

catch of 9358 tonnes of sciaenids was landed and more than 98% of the sciaenid catches was realised from trawlers. Thus about 9208.0 tonnes of sciaenids were realised from trawlers while the remaining 150 tonnes were landed by gill nets. Peak landings of sciaenids are obtained during May-June and December-March and C.P.H. was recorded in June '83.

O.cuvieri, O.brunneus, P.diacanthus, S.glauca and *Johnius vogleri* were the important species among the sciaenids. *O.cuvieri* contributed to more than 68% of the total sciaenids.

O.cuvieri ranging in site from 80-300 mm, were studied for length frequency distribution. 0-year and 1-year age-group fishes contributed to the catches.

It is observed that *O.cuvieri* feeds mainly on prawn such as *Acetes* sp. *Solenocera* sp. and to a lesser extent on teleosteans. In most of the months, the ovaries were in maturing condition. Only in March mature ovaries are seen.

Calicut: During the year, an estimated total catch of 64 tonnes of sciaenids was landed at Vellayil, Calicut from mechanised trawlers and from indigenous units. There was a decline in the catches when compared to corresponding period of last year. September-October was found to be the peak period for the sciaenids fishery. In the indigenous gear about 39.7 tonnes of sciaenids were realised.

Oruber, O.argenteus, J.belengeri were important species which contributed to 70% of the total sciaenids catches. Length frequency studies were carried out on *J.sina*. During the first quarter females in stage III-IV, dominated in the population. In July, the sex ratio between males and females was equal, while males dominated in September and October. The reverse was the case in November '83. During the period November-March mature fishes were noticed in the catches.

Resource characteristics of silver bellies (F5/DR/1.8.5)

V. Sriramachandra Murthy, S. Srinivasarengan And S. Livingston

I. *Fisheries:* At Kakinada, an estimated 2107 tonnes of silver bellies were landed by private trawlers, which formed 10% of total trawl catch. Peak catches and catch rates were obtained during July-October period. The silver belly catch showed an increase of 116% over previous year along with about 23% increase in effort.

At Madras an estimated 762 tonnes of silver bellies were landed by private trawlers which formed 10.3% of total trawl catch. The monthly catches ranged from a minimum of 35 tonnes in December 1983 to a maximum of 120 tonnes in January 1984. The catches and catch rates were good in October, November and January.

At Kakinada, a total of 9 species contributed to the fishery; of these, *Leiognathus bindus* and *Secutor insidiator* were most abundant, together forming about 78% of silver bellies landed. The catches of these two species showed considerable increase over the previous year (111% and 134% respectively)

At Madras 14 species contributed to the fishery and *Leiognathus bindus, Gazza minuta, L.splendens* and *S.insidiator* were most abundant.

II. *Biology: L.bindus:* At Kakinada the length range of the catch was 22-142 mm and at Madras the same was 32-127 mm. At Kakinada, smaller fishes forming modes between 27 and 42 mm occurred in April, July, August, October and January; at Madras the smallest modal length was 42 mm in December.

Mature adults occurred in considerable numbers during almost all months at Kakinada and Madras. Gravid individuals occurred during April-June and September 1983 and February and March 1984 at Mardas with peaks during April and September. At Kakinada mature and gravid adults occurred in almost all months for which data are available.

2. *S.insidiator:* The length range of catch was 27-112 mm at Kakinada and 32-117 mm at Madras. Smaller fishes with modal lengths ranging from 37 to 47 mm occurred in June, August, September and November at Kakinada and in April at Madras. Gravid adults occurred during July-August and February-March at Kakinada with peaks during August and February. At Madras gravid adults occurred during April, May, September and November 1983 and January and February 1984, with peaks during April and January.

Estimation of major demersal fish resources (FB/DR/1.9)

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Veraval: Data from the landings of the commercial mechanised vessels using trawl and gill-nets, which are the chief demersal fishing gear at this centre, have been analysed.

The total estimated catch of demersal fishes was 42,483 tonnes, in which trawl and gill-net contributed 41,403 and 1,080 tonnes respectively. The percentage of demersal fishes in the trawl and gill-net was observed to be 45.09 and 31.83 respectively in total estimated fish landings at Veraval. The catch rates in trawl and gill-net were 60.33 and 3.61 kg/hr. respectively. July-August were lean months.

The main groups caught were sciaenids 20%) *Lactarius* (16%) *Nemipterus* (6%) and lizard fishes (5%). Prawns made up (nearly 5% of the catch, while crabs contributed 10% and squids 3%.

Cochin: The total estimated landings of the trawlers at the Cochin fishing harbour was estimated to be 8813 tonnes for a fishing effort of 44,370 units at a catch rate of 198.64 kg/unit. The total catch and catch rates were found to be the highest in July and the lowest in June. When compared to the previous year the fishery showed an upward trend, though there was a slight reduction in the fishing effort.

The penaeid prawns constituted mainly by *Metapenaeus dobsoni* and *Parapenaeopsis stylifera* formed 45.09% of the total annual demersal catch, the landings being 3,974 tonnes at a catch rate 89.57 kg/unit. It may be noted that except during monsoon (June-September), the fishing effort is mainly directed towards the capture of penaeid prawns. During monsoon the effective fishing effort is mainly for threadfin breams and lizard fishes.

The total estimated fin fish catch was 4672 tonnes at a catch rate of 105.31 kg/unit. The major demersal species that formed the catch in the order of abundance were threadfin breams *N.japonicus* and *N.mesoprion* (22.06%), sciaenids, mainly *Johnieops sina, J.dussumieri, J.carutta* and *Otolithes ruber* (492 tonnes constituting 10.53%) and soles (540 tonnes forming 11.55%) comprising mainly *Cynoglossus macrostomus.* Cat fishes like *Arius thalassinus, A.tenuispinis* and *A.maculatus,* lizard fishes like *Saurida tumbil, S.undosquamis* and *Trachinocephalus myops,* leiognathids and barracudas like *Sphyraena jello* and *S.obtusta* were the other important demersal constituents of the trawl catch.

The oil sardine, anchovies like *Stolehorus devisi* and *S.bataviensis,* carangids mostly *Alepes para,* ribbon fishes constituted mainly by *Trichiurus lepturus* etc. formed a significant portion of the shrimp trawler catch in certain months.

Stomatopods formed another major portion of the catch (3.62%), the landings being 328 tonnes. The total cephalopod catch was 328 tonnes at a catch rate of 1.03 kg/unit, the main species represented in the catch being *Sepia aculeata, S.elliptica, S.pharaonis* and *Loligo duvaucelli.*

Mandapam: An estimated total of 15,422 tonnes was landed from the three major fishing areas as shown below:

	Effort (unit)	Catch (kg.)	CPUE
Pamban	10,668	714,723	67.0
Rameswaram	79,739	12048,999	151.1
Mandapam	37,864	2658,625	70.21
	128,291	15422,347	120.21

Silver bellies contributed 92% of the day landings and 44% of night landings.

Madras: Four EFP Vessels, the medium-sized 'Meengaveshak' and 'Meena sitara' and the large 'Matsya jeevan' and 'Matsya harini' trawled off Madras and data from the available log sheets for the 3 quarters show an estimated catch of 52,000 kg. for an effort of 411-4 hr. at a catch rate of 126.44 kg./hr.

Kakinada: An estimated 21,002 tonnes of fish (including 5780 tonnes of prawns which formed 27.5% of total catch) were landed by the trawlers at Kakinada and Bhairavapalem centres together, with an average catch per unit of effort of 59.0 kg./hr. The catches showed an increase of 24% over previous year along with an increase of 34% in *Pablo* units, 17% in *Pomfret* units and 36% in *Sorrah* units operated. All the constituent demersal groups showed increase over the previous year, ranging from 6.5% to 205.3%. More than 100% increase was obtained in sciaenids, silver bellies, and perches.

Waliair: An estimated 8428 tonnes of fish were landed by the three types of vessels (*Pomfret, Royya* and *Sorrah*) as shown below:

	Pomfret & Royya			*Sorrah*		
	Effort (hr.)	Catch (kg)	CPUE	Effort (hr.)	Catch (kg)	CPUE
I Quarter	44691	1843,492	41.25	4879	198,964	40.78
II Quarter	85615	2522,898	29.47	8463	269,263	31.68
III Quarter	79390	1817,942	22.90	9110	206,634	22.68
IV Quarter	82210	1427,803	17.37	9323	140,576	15.08
	91906	7612,135	26.08	31775	815,437	25.66

An increase of 39.7% in units and 59.3% of trawling hours resulted in 84.3% increase of all fish catch by the *Pomfret* and *Royya* vessels. In *Sorrah* type of vessels an increase of 22.4% of catch was observed by an increase of 6.4% unit effort and 13.8% trawling hours. The present year's catch increase is also attributed to higher catch rates, from 22.6 kg. to 26.1 kg. in *Pomfrets* and *Royyas* and 23.8 kg. to 25.7 kg. in *Sorrahs.*

The important groups landed were: Prawns (1174,444 kg., 14%), *Nemipterus* (1164,781 kg.,14%) ribbon fish (672,353 kg.,8%) *Saurida* (581,388 kg.,7%) silver bellies (554,618 kg.,7%) and *Priacanthus* (435,447 kg.,5%).

Prawns and *Saurida* sp. occupied the first ranks in abundance during the two years. Leiognathids which were in third place during 1982-83 came third in 1983-84 also. *Upeneus* sp. which occupied sixth rank in 1982-83 had gone down to tenth in 1983-84. *Johnius carutta* (eight place in 1982-83) remained at the same position in 1983-84 also.

Mariculture-Culture of fin-fishes (FB/CUL/1.1)

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Mandapam: Field trips were made to Manoli Island and Thonithurai for the collection of fish fry of different species. 40017 fry and 6048 fingerlings of milk fish, 4036 fry and 8479 fingerlings of *V.seheli*, 700 fingerlings of *L.macrolepis* and 1350 fry of *Siganus canaliculatus* were transported with minimum mortality. The transported fish fry were stocked in a nursery pond.

In monoculture system, *V.seheli* showed a growth rate of 10.8 mm (3.9 g), 19.8 mm (17.4 g) and 9.0 mm (3.0 g) in experiment I, II and III respectively after a rearing period of 10 months. The production per hectare and survival were 200 kg. (91%), 290 kg. (22%) and 230 kg. (74%) in respect of Experiment I, II and III.

In polyculture system, milk fish registered a monthly growth rate of 23.5 mm (18.5 g) and the mullet *V.seheli* of 19.9 mm (9.4 g). The rate of production was 872 kg/hr. with 70% survival and 67 kg/hr. with a survival of 20.7% for milk fish and *V.seheli* respectively.

In a fresh experiment initiated during November, '83 with different stocking densities, milk fish showed the monthly growth increase of 26.2 mm (10.8 g) in pond No.9, 27.5 mm (20.8 g) in pond No. 14 and 30.8 mm (14.0 g) in pond No.18.

Regarding induced breeding experiment, 4 female fish of *L.macrolepis* were injected with the extract of major carp pituitary gland. One fish spawned 55.30 hrs. after the 1st dose of injection. But the fertilized eggs did not develop further.

A study on the occurrence of milk fish fry at Manoli Island was initiated in April '83. The fry were abundant during the month of May '83 and very few numbers recorded in November '83 probably indicating the secondary spawning of this fish.

Madras: Fry and fingerlings of milkfish, *Chanos chanos*, mullets *Liza macrolepis*, *Liza cunnesius* and *Mugil cephalus*, sandwhiting *Sillago sihama* and *Etroplus* spp. were collected from tidal pools and backwaters of Kovalam and Adayar estuary and stocked in the nursery ponds 1-3 for culture experiments at the Mariculture Centre, Muttukadu, during the period under report.

In monoculture of milkfish *Chanos* at the mean size of 36.4 mm/0.4 g were stocked @5000 nos/ha during June, 1983. The mean growth rate of *Chanos* after six months period was recorded as 234.3 mm/79 g with a mean monthly length and weight of 32.9 mm/12.5 g respectively. After six months during December, 1983, the harvested *Chanos* yielded 366 kg/ha/yr.

In monoculture experiments with mullets 1000 nos. of *Liza macrolepis* were stocked @ 2500 nos/ha during January, 1984. At the time of stocking, the mean length and weight of *L.macrolepis* were found to be 32.6 mm/0.6 g. After three months period during March, 1984, *L.macrolepis* have grown to the mean size of 84 mm/8 g, the growth rate being 26 mm/4 g per month.

In polyculture of *Chanos* and *Penaeus monodon*, 750 nos. of *Chanos* of mean size 24.4 mm/1 g were stocked @ 500 nos/ha during June, 1983. *Chanos* have grown to 231.8 mm/90.9 g at harvest in a period of six months, regsitering a growth rate of 34.5 mm/15.1 g per month. The production rate was estimated as 220 kg/ha/yr. *Penaeus monodon* at mean size of 17.8 mm/

0.029 g were stocked @ 5000 nos/ha. At harvest the average size was 135.1 mm/18.5 g, the growth rate being 19.5 mm/3.0 g per month. The yield works out to 90 kg/ha/yr.

In culture of three species of mullets together, 325 nos. of *Liza macrolepis* at mean size 57 mm/2 g and 325 of *Liza cunnesius* at 53.7 mm/1.5 g were stocked @ 5000 nos/ha during January, 1984. *L.macrolepis* had growth to the mean size of 113.7 mm/14.7 g and *L.cunnesius* to be 105.3 mm/11.6 g after two months.

In another experiment 1000 nos. of *Liza macrolepis* at 40.0 mm/1 g and 200 of *Mugil cephalus* at 45.5 mm/1 g were stocked @ 3000 nos/ha during January, 1984. After two months in March 1984 the mean size was recorded as 98.8 mm 10.7 g for *L.macrolepis* and 93 mm/9.2 g for *M.cephalus*.

Calicut: Monoculture experiments on four species of fishes such as *Chanos chanos, Mugil cephalus, Etroplus suratensis* and *Megalops cyprinoides* were conducted during the year under report in the polyethylene film lined ponds at Calicut after relining and reconditioning the ponds.

A total of 4127 seed of the milk fish ranging in size from 15 to 62 mm total length was collected during the month of July. The bulk of the collection was made from the mouth of Varakkal Thodu rivulet in the water logged areas between the road and the beach at West Hill. Three ponds were stocked at a uniform density of 1 no./m^2 water area and harvested after 180 days.

Pond No. 13 gave better production (1751 kg/ha) and pond No. 10 gave better survival rate (88.8%). Though the fishes were stocked with a higher mean size of 53.6 mm in pond No.1 the production as well as survival rates were found to be low in that pond. Because of low survival rate in that pond the fishes showed a higher weight increment of 1.48 g/day. The pond (No. 10) in which the maximum survival rate was recorded had a minimum weight increment for the fish (0.87 g/day). In pond No. 12 which was harvested almost 180 days after stocking a production of 1882 kg/ha was obtained mainly because of the higher stocking density (2/m^2) the pond had. Though the stocking density was double that of the other three ponds which were harvested almost during the same period, comparatively better survival rate could be obtained in pond No. 12. But compared to the other three ponds the mean size of the fish at the time of harvest was smaller (259.6 mm length and 130.4 g weight). Pond No. 1 gave the maximum mean size of 332.7 mm length and 271.4 g weight at harvest. The higher stocking intensity in pond No. 12 had an adverse effect on the growth increment of the fish (0.72 g/day).

The stock of *M.cephalus* was harvested on the 142nd day of stocking. Out of 154 fish stocked at the time of harvest a total of 74 numbers were caught giving a survival rate of 48.1%. An increase of 0.78 mm in length and 0.69 g in weight per day was noticed during the period of culture. The quantity harvested was 8.4 kg.

Megalops seed were collected from the same grounds and a total of 188 numbers thus collected with a mean size of 22.8 mm were stocked in a pond having 135 m^2 water area at a rate of 1.5/m^2 on 2-7-83. A daily length increment of 1 mm in the first quarter, 0.6 mm in the second quarter and 0.5 mm in the third quarter was recorded, the daily weight increment being 0.1 g in the first quarter, 0.2 g in the second quarter and 0.4 g in the third quarter. No artificial feed was given to this stock during the entire period of observation. From 22.8 mm length and 0.025 g weight the fish has grown to 197.5 mm length and 64.3 weight within a period of 9 months without supplementary feeding.

Fish culture in cages: In culture of fishes in cages at Mandapam Camp, the cages were got ready by February and groupers of size 70-120 mm, 130-140 mm and 150-250 and snappers of size 110-150 mm were stocked separately, and fed with chopped trash fish at 10% their body weight and seed of *Siganus canaliculatus* were also collected and kept in the laboratory for preliminary studies on their suitability for culture in cages.

Fish culture in pens: The milk fish *Chanos* was cultured in the fish pens in the Pillaimadam lagoon at Mandapam. Two fish pens 0.5 ha and 1.0 ha in area were stocked with *Chanos* fingerlings of length 90-114 mm. The fishes attained a length of 312 mm weighing 210 g in a period of 132 days. 50 kg. of fishes were harvested from one of the 0.5 ha pens.

In the 1 ha pen harvest could not be done due to the cyclonic weather during the first week of December resulting in the damage of the webbing. This pen was stocked with 2927 fingerlings of *Chanos*. The stock was lost during the cyclone.

The fishing activity of the lagoon was also monitored to compare the growth of *Chanos* in the natural environment and in the pens. It was observed that the *Chanos* in the pens grew more or less at the same rate as the *Chanos* in the lagoon.

CRUSTACEAN FISHERIES DIVISION

The salient features of the capture fisheries for crustaceans during the year 1983-84 are as follows: There was a decline in the catch of *Parapenaeopsis stylifera* and *Metapenaeus dobsoni* along the south-west coast of India. But on the east coast the fishery for *P.indicus, P.semisulcatus* and *M.monoceros* showed improvement in many centres. Stock assessment studies at Cochin and Saktikulangara Centres showed that the populations of *P.stylifera* and *M.dobsoni* are exploited at the maximum level and that any further increase in fishing pressure will be detrimental to these stocks. Juvenile recruitment in the estuarine areas was better in all the centres except Cochin. Gujarat and Maharashtra lead in spiny lobster production with *Panulirus polyphagus* as the dominant species, while the stomatopod fishery was good in Karnataka and Kerala, *Oratosquilla nepa* being the only species.

On the culture side, the hatchery technology for penaeid prawns was further simplified and perfected. A major breakthrough was the development of techniques for artificial insemination of the tiger prawn *P.monodon*, which has opened new vistas in selective breeding and genetic manipulation of penaeid prawn stocks. The zoea of the crab *Scylla serrata* were successfully reared in the laboratory to the crab stage.

Assessment of penaeid prawn resources (CF/RE/1.1.1)

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In the year 1983-84 penaeid prawns registered increased landings over the previous year at New Ferry Wharf, Sassoon Dock, Malpe, Calicut, Cochin, Tuticorin, Madras, Kakinada and Waltair. Penaeid prawn catches declined at Veraval, Karwar, Mangalore, Saktikulangara and Puri. A marginal decline in the landings was recorded at Paradeep.

The estimated penaeid prawn landings along with catch per unit effort, species composition, peak fishing months and price structure at different centres are given in Table 4.

At Veraval penaeid prawn catch and catch rate declined during the reporting

Table 4. Penaeid prawn fishery at various centres in 1983-84

	Gujarat	Maharashtra		Karnataka			Kerala			Tamilnadu		Andhra Pradesh		Orissa	
	Veraval	Sassoon Dock	New Ferry Wharf	Karwar	Malpe	Mangalore	Calicut	Cochin	Saktiku-langara	Tuti-corin	Madras	Kakinada	Waltair	Puri	Paradeep
Mechanised Fishery															
(a) Catch in tonnes	1690	10818	9746	684	795	1582	275	3977	8174	326	482	4192	1155		679
(b) Catch/effort (kg/hr)	2.5	59.0	379 (per unit)	7.4	24.6 (per unit)	5.3	55.0 (per unit)	22.20	12.3	1.5	2.9	11.8	3.4		5.1
(c) Important species*	j, l, c, k, i, e, b	b, j, c, d, l m	j, b, c, l, m, k	j, c, a, b, g, h	a, j, c, f, b, h	j, a, e, f, b, h	j, a, f, b, c, h	j, a, f	j, b, f, a	i, f	a, f, c	c, a, f, a, j	a, c, f, m		b, c, a, h j, k
(d) % of prawns	3.1		23.3				23.6					20.0			
(e) Productive months**	10, 12, 1		10, 9, 11,	9, 4, 10, 4, 5, 1, 3	9, 5, 4, 12, 2 5, 1, 3	1, 3, 2, 4, 5	7, 5, 6, 4, 1	7, 5, 4, 12, 3	8, 7, 5, 9, 12	9, 10, 8, 11, 12	2, 1, 11, 3, 12	7, 1, 9, 3, 2	8, 9, 12 7, 1		12, 10,1, 9, 2
Indigenous Fishery															
(a) Catch in tonnes			27	301 (purse seine)	1244 (purse seine)		67					135			66 (gillnet)
(b) Catch/effort (kg/hr)			30.4	211 (per unit)	438 (per unit)		9.2 (per unit)					0.4			0.2
(c) Important species*			j, a, g	a, f	a, f		a, j					f, a, d, h, g			g, b, a
(d) % of prawns							1.1					3.8			
(e) Productive months**			8	9	9		7, 8, 6					12, 5, 7, 1			10, 11, 9, 4
Price structure (Rs/Kg)															
Large		60–100	46–60	40–80	49–85		60–70	60–90				60–75			
Medium		25–50	30–34	31–40	31–49		30–40	30–45				30–45			
Small		12–20	15–21	11–17	10–19		8–20	8–13				7–12			
Tiny		4–10	5–10	5–10	5–10		—	6– 8				1– 5			

* a–*M.dobsoni* b–*M.affinis* c–*M.monoceros* d–*M.brevicornis* e–*M.brevicornis* f–*P.indicus* g–*P.merguiensis* h–*P.monodon*
i–*P.semisulcatus* j–*P.stylifera* k–*P.hardwickii* l–*S.crassicornis* m–*M.stridulans*

** *Calendar Months.*

Table : 5 Percentage of penaeid prawn species at different centres in trawl fishery (Indigenous gear in parenthesis)

	Gujarat	Maharashtra		Karnataka			Kerala			Tamil Nadu		Andhra Pradesh		Orissa	
	Veraval	New Ferry Wharf	Sasoon Dock	Karwar	Malpe	Mangalore	Calicut	Cochin	Saktiku-langara	Tuti-corin	Madras	Kakinada	Waltair	Puri	Paradeep
Solenocera crassicornis	21.8	11.6	4.0										1.2		3.1
Penaeus indicus							4.7 (0.7)	4.5	8.6	52.1	25.9	12.3 (36.1)	11.5	(14.6)	
Penaeus merguiensis				0.5 (0.2)	3.4 (2.1)	5.4						0.9 (2.7)		(55.6)	2.7
Penaeus monodon				0.2 (0.5)	0.7	1.0	0.7		0.2		1.0	5.4 (2.8)	1.2	(2.6)	8.1
Penaeus semisulcatus	8.5								0.1	47.9	3.9	2.1	1.7		
Penaeus penicillatus	1.8											(2.0)			
Metapenaeus dobsoni				12.1 (11.1)	46.0 (97.7)	31.4	19.5 (76.5)	32.7	6.0		59.6	18.5 (32.1)	38.3		16.3
Metapenaeus affinis	3.6	19.9	38.0	6.8 (0.7)	2.1	1.9	4.7 (1.8)	2.6	14.6			2.8 (1.3)		(26.8)	28.1
Metapenaeus monoceros	17.4	16.3	12.0	15.0	11.0	20.7	1.9	1.1	1.9		9.6	28.0 (2.6)	25.3	(0.4)	22.4
Metapenaeus brevicornis		1.4	6.0									7.5			
Metapenaeus kutchensis	3.9											(6.4)			
Parapenaeopsis strlifera	25.7	36.3	34.0	65.4 (81.1)	36.8	39.5	68.5 (21.0)	59.1	68.1			8.7 (9.9)			5.8
Parapenaeopsis hardwickii	11.5	3.9										2.3			4.5
Parapenaeopsis sculptilis												(2.4)			
Metapenaeopsis stridulans		4.9											7.6		1.3
Other penaeid prawns	5.8	5.7	6.0			0.1			0.5			11.5 (2.6)	13.2		7.7

Table : 6 Size distribution and peak spawning months (in parenthesis) of prawns in different centres during 1983-84

Species	Gujarat	Maharashtra			Karnataka			Kerala		Tamil Nadu		Andhra Pradesh		Orissa	
	Veraval	New Ferry Wharf	Sasoon	Karwar	Malpe	Mangalore	Calicut	Cochin	Saktiku-langara	Tuti-corin	Madras	Kakinada	Waltair	Puri	Paradeep
S.crassicornis	31-120 (12, 1, 2) *														
P.indicus									91–220 (9, 1, 2)	111–215 (5, 6, 10, 11, 12, 1, 2, 3)	96–210 (12, 1, 2, 3)				
P.merguiensis														121–205 (8, 9, 1, 2)	
P.semisulcatus										101–230 (11 12, 1, 2, 3)					
M.dobsoni					51–125 (9, 2, 3)	51–125 (9, 10)	46–120 (10, 11, 12)	46–120 (8, 12, 1)			66–145 (8, 9, 3)	46–115 6, 9, 12)	31–120 (10, 11)		
M.affinis		71–190 (6, 7)	85–150 (1, 3)						86–140					91–175 (8, 9, 10, 1, 2, 3)	76–175 (8, 9, 12, 1, 3)
M.monoceros				76–190 (1, 3)								51–200 (6, 7, 12)	66–205 (7, 9, 11, 2, 3)		71–185 (12, 1, 2, 3)
P.stylifera	51-145 (10, 11, 12, 1, 2)	61–135 (10)	76–115 (10)	56–125 (1, 3)	46–120 (2, 3, 4, 5)	26–130 (3)	46–135 (4, 5, 6)	36–120 (9, 10, 11, 12, 2)	31–125 (7, 9, 12, 1)						

* Calendar months

year. Catches of *M.affinis, P.stylifera* and *S.crassicornis* registered decline. However, *M.monocceros* and *P.penicillatus* showed improved landings.

At both centres in Maharashtra penaeid prawns showed increased catches over that of the previous year. The prawn catch for the year 1983-84 at New Ferry Wharf was highest compared to the earlier years 1979-83. *P.stylifera* showed sizeable increase in the landings at New Ferry Wharf.

Penaeid prawn landings at Karwar and Mangalore in Karnataka were poor. At Karwar the catch declined by 27.5 % over that of the previous year. *P.stylifera* contributed to 65% of the prawn catch. At Malpe trawl landings improved, whereas purse seine prawn catch marginally declined. *M.dobsoni* (45.98%) and *P.stylifera* (36.84%) accounted for the bulk of the catch. At Mangalore penaeid prawn landings declined by around 20%. This was largely due to the decline in the landings of *P.stylifera* and *M.dobsoni*.

In Kerala prawn landings improved at Calicut and Cochin whereas at Saktikulangara, the most important prawn fishing centre in the State, the catch and catch rate declined. At Cochin Fisheries Harbour both catch and catch rate for prawns registered increase. This was due to the increased landings of *P.stylifera*. At Saktikulangara the monsoon prawn fishery for *P.stylifera* was a failure resulting in the lower catch and catch rate for prawns.

On the east coast, in Tamil Nadu, at Madras and Tuticorin, both catch and catch rates registered increase. Higher catch and catch rates were recorded in Andhra Pradesh too. In Orissa, trawler landings declined marginally at Paradeep.

Species composition in different centres is given in Table 5. On the west coast, *P.stylifera* was the dominant species in most centres except Sasoon Dock and Malpe. At Sassoon Dock *M.affinis* was the dominant species and *M.dobsoni* at Malpe. In Kerala *P.stylifera* was the dominant species at all centres. Good landings of *M.dobsoni* occurred at Calicut and Cochin Fisheries Harbour. At Tuticorin *P.indicus* (52.1%) and *P.semisulcatus* (47.9%) contributed to the entire prawn fishery. *M.dobsoni* (59.6%) followed by *P.indicus* (25.9%) were dominant species at Madras. *M.monoceros* dominated at Kakinada and *M.dobsoni* at Waltair. In the trawler landings at Paradeep *M.monoceros* and *M.affinis* were dominant species. In the indigenous fishery at Puri *P.merguiensis* was the principal species.

In Gujarat and Maharashtra September to December is the productive period. In Karnataka, March to May and September are peak periods for prawn fishery. In Kerala peak season is during south west monsoon from June to August at Saktikulangara. At Cochin and Calicut best landings are obtained from April to July. In Tamil Nadu August to December is the productive period. In Andhra Pradesh good catches are recorded from July to September. In Orissa winter season is the best for prawn fishery.

The size of *S.crassicornis* at Veraval ranged between 31 and 120 mm. *P.indicus* measured from 91 to 210 mm in the east coast as well as the west coast. *P.merguiensis* which supported the indigenous fishery at Puri showed a size range of 121-205 mm. *P.semisulcatus* was one of the major contributors to the prawn fishery at Tuticorin and those measuring 101-230 mm were observed in the catches. The size ranges of *M.dobsoni* were 46-135 mm and 31-145 mm in the west coast and east coast respectively. *M.affinis* measuring 71-190 mm contributed to the prawn fishery in both coasts. Larger size groups of *M.monoceros* were present in the fishery in the east coast. *P.stylifera* of size range 26-145 mm supported the prawn fishery along the west coast. Most of the species exhibited prolonged spawning seasons and the peak spawning months are given in Table 6.

Assessment of non-penaeid prawn resources (CF/RE/1.1.2)

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The non-penaeid prawn landing at the various centres of observation are given in Table 7.

Table 7

Non-penaeid catch in tonnes and C/U in kg

Centre	Gear	1983–84 Catch	1983–84 C/U	1982–83 Catch	1982–83 C/U
Veraval (Navabunder)	*Dol*	807	35.2	643.7	26.3
Bombay					
(i) Versova	*Dol*	3170.1	362.5	1992.2	189.8
(ii) Sasoon Dock	*Dol*	621.4	73.7	1113.1	86.1
	Trawl	240.1	15.6	142.5	6.3
(iii) New Ferry Wharf	*Dol*	76.2	57.3	63.9	110.2
	Trawl	121.2	4.7	5.3	0.2
Kakinada					
(i) Fishing Harbour	Trawl	1588.0	29.0	1055.6	22.0
(ii) Uppada	Seines	44.3	0.7	60.5	0.97
Total (Kakinada)		1632.3	—	116.1	
(iii) Backwaters	Drag	81.5	6.2 (Drag net)	148.2	2.2 (Drag net)
	Stake		2.3 (stake net)		3.5 (Stake net)
	Push nets				

The marine fishery accounted for 198 tonnes at New Ferry Wharf (Bombay) and 1632 at Kakinada. There has been considerable improvement in the catch compared to 1982-83. Though no data are available for January-March, 1984 from Bombay (Versova and Sassoon Dock), there are indications from the average projected figure for January-March of the earlier years that the fishery during the current year at these centres has also been considerably augmented. On the other hand the backwater fishery at Kakinada declined to 55% of the previous year's catch.

Acetes indicus was the major constituent at Veraval and Bombay. At Kakinada also *Acetes* spp. was dominant in the marine catch. Next in importance were *Nematopalaemon tenuipes* and *Hippolysmata ensirostris* at all the marine landing centres whereas in the backwaters of Kakinada *Macrobrachium* spp were the most common. (Table 8.).

Table 8

Percentage composition of non-penaeid prawn catch

Species	Veraval	Bombay @	Kakinada	
			Marine	Backwater
Acetes spp.	44.7	30.0	38.9	3.8
N.tenuipes	21.8	69.0	38.1	—
H.ensirostris	22.5	1.0	2.7	—
N.styliferus	11.0	—	0.3	7.6
Macrobrachium spp	—	—	—	88.6
Others	—	—	0.5	—

@ Relates to New Ferry Wharf centre

The size of the commercial species caught at the various centres is given in Table 9. Generally females were seen to out number the males. Precentage of berried individuals among *N.tenuipes* and *H.ensirostris* was high during April-June and November-December at Bombay and Veraval and during July September and December at Kakinada.

Table 9

Size range and modal size range (in parenthesis) of non penaeid prawns at three centres

Centre	Gear	Species	Size (mm)
Veraval	*Dol*	*N.tenuipes*	23–67 (41–52)
		H.ensirostris	36–105 (76–85)
Bombay	*Dol*	*A.indicus*	13–35
		N.tenuipes	47–70
		H.ensirostris	52–62
Kakinada	Trawl	*N.tenuipes*	30–86 (42–56)
		H.ensirostris	26–85 (52–58)

Assessment of prawn resources in the nursery grounds (CF/RE/1.1.3)

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Monitoring of the rate of recruitment and commercial exploitation (Table 10) of penaeid prawns in the estuarine environments was carried out from Karwar, Mangalore, Calicut, Cochin, Quilon, Madras, Kakinada and Puri. In all these centres, except Cochin, an increase in abundance of the young prawns was noticed this year as compared to the previous year. This suggests an improvement in the fishery for their adults in the marine environment of the respective centres

Table 10 Estuarine prawn fishery at selected centres during the year 1983-84

	Karwar	Mangalore	Calicut	Quilon	Madras ..	Kakinada	Puri
Estimated catch in tonnes	40.8	14.5	114.8	219.1	38.8	933.3	26.4
CPUE in kg/net	3.11	0.2 @	2.5 +	1.1	—	24.2	0.02
Fishing gears	Sluice nets	Cast nets & seines	Stake nets	Stake nets	Stake ntes	Stake nets and drag nets	Trap
Important species	*M.dobsoni M.monoceros*	*M.dobsoni, M.moyebi, P.indicus*	*M.dobsoni, M.monoceros, P.indicus.*	*M.dobsoni , P.indicus, M.monoceros*	*P.indicus, M.dobsoni, M.monoceros*	*M.monoceros, P.indicus, M.dobsoni, P.monodon.*	*P.indicus, M.dobsoni M.monoceros, P.monodon*
Peak fishing season	March	June-July, & Nov.-Jan.	April-June & Nov.-Jan.	April-May, Nov.-Dec. & March	November-December	July-Sept., & Nov.-Dec.	October & February

@ For cast nets
+ Catch/hour

during 1984-85. The most dominant species encountered in this environment were *Metapenaeus dobsoni* throughout the southwest coast, *Penaeus indicus* in Tamilnadu and Orissa, and *M.monoceros* in Andhra Pradesh. While *M.dobsoni* showed greater recruitment in most of the centres except in Cochin backwaters, a general decline in the incursion of *P.indicus* was observed in the estuaries of Karnataka and Kerala this year. Juveniles of *P.merguiensis* was, however, noticed in greater numbers at Karwar and that of *M.moyebi* at Mangalore, which would indicate the possibility of the existence of better stock of the adults of these species in the adjoining sea for commercial exploitation. In Ennore estuary, the postlarval abundance of penaeid prawns has been found to be generally higher on new moon nights, and relatively denser population of the juveniles were observed at stations farther from the bar-mouth. Juveniles of *P.monodon* were recorded in sizeable quantities in the estuaries and backwaters of the northeast coast. The major size groups of prawns supporting the commercial fishery were 31-55 mm for *M.dobsoni*, 31-95 for *M.monoceros*, 66-115 mm for *P.indicus* and 90-200 mm for *P.monodon*. In Ashtamudi backwaters, relatively larger size groups of *M.dobsoni* (61-80 mm) dominated in the stake net catches.

Evaluation of penaeid prawn fishery with special reference to fishing effort, size distribution and dynamics of the resources of selected centres (CF/RE/1.1.4)

M.J. George, K.N. Rajan and C. Suseelan

In continuation of the studies carried out during the previous years a detailed analysis of the monsoon prawn fishery of Sakthikulangara in Kerala was undertaken with a view to evaluate the extent of overfishing of the major species involved and the effect of fishing on the size of the shrimps. The stock assessment studies on the two important species namely *Parapenaeopsis stylifera* and *Metapenaeus dobsoni* at this centre as well as at Cochin indicated that,

in *P.stylifera*, though natural mortality remains almost the same for both the sexes the fishing mortality for males is double than that of females in the fishery at Cochin and more than three times at Saktikulangara. This would indicate that the differential fishing pressure on the different sexes of the species at both these centres, especially the lesser pressure on the females would help in maintaining the recruitment rate resulting in a sustainable yield. In the case of *M.dobsoni* at Cochin both natural and fishing mortality rates for males and females do not show as much difference as in *P.stylifera*. This would indicate that in this species both the sexes are more or less equally exploited.

Studies on yield-effort relationship indicated that the present level of exploitation of *P.stylifera* males is quite high resulting in an yield almost touching the maximum. In the case of *M.dobsoni*, both males and females are under maximum exploitation at Cochin. The studies have shown that any further increase in fishing pressure for the exploitation of the above resources will be detrimental to the stock.

Shrimp and other crustacean resources beyond the littoral zone of EEZ (CE/RE/1.1.5)

ALL SCIENTIFIC STAFF OF THE C.F.D.

A survey of the deep-sea prawn resources of the shelf-edge and upper continental slope between Mangalore and Bombay was conducted during March, April 1984 on board R/V Skipjack.

Assessment of lobster and crab resources (CF/RE/1.3)

P.V. KAGWADE, E.V. RADHAKRISHNAN, V.D. DESHMUKH AND K. Y. TELANG.

The estimated landings of lobsters during the year 1983-84 was slightly lesser than the catch recorded during the previous year in all the observed centres except Veraval. Increased effort was observed at Veraval and Bombay. The catch went up to 201 tonnes during 1983-84 from 27 tonnes during 1982-83. *Thenus orientalis* was the predominant species at Veraval, Bombay and Madras. Among the spiny lobsters *Panulirus polyphagus* and *P.homarus* were the dominant species in the north west and south west coasts respectively. High yields of lobsters were observed in January at Bombay and Veraval, in February at Madras and in September at Tuticorin.

The crab landings showed improvement at Mangalore centre alone during this year. The catches declined markedly from 1052 tonnes during 1982-83 to 795 tonnes during 1983-84 at Kakinada. *Portunus sanguinolentus* and *P.pelagicus* were the important constituents of the fishery. The maximum catches were observed during the months of March, January, May and July at Veraval, Mangalore, Madras and Kakinada respectively.

Prawn Fishery Atlas (CF/RE/1.4)

E.G. SILAS, K. RENGARAJAN, S.K. DHARMARAJA AND I. DAVID RAJ

During this year the prawn landings for the year 1980 by the Exploratory Fisheries Project and Integrated Fisheries Project vessels were analysed. Monthwise data were sorted out and processed for monthwise, areawise and statewise landings. The processed data gives the total landing of fish, the total landing of prawn, the fishing effort in hours, the catch rate of prawn in kgs., the percentage of prawns in the total catch etc. The different types of gear employed were also noted. The export of prawn and prawn products to different countries, total quantity and value of export, itemwise export, country wise export, percentage of export to different countries were gathered.

Assessment of Stomatopod resources (CF/RE/1.7)

M.M. KUNJU, D.B. JAMES, N.S. KURUP, K.K. SUKUMARAN, G. NANDAKUMAR AND G. SUDHAKARA RAO

Investigations on stomatopod resources were carried out from Karwar, Mangalore, Malpe, Calicut and Cochin on the west coast and Waltair and Madras on the east coast. Stomatopods formed a sizeable portion of the trawl catches, yielding an average of about 2-24 kg/hr of trawling on the west coast and 0.1 - 0.3 kg/hr on the east coast. The estimated landings for the year worked out to 418 t at Cochin, 2331 t at Mangalore, 1593 t at Malpe, 1367.5 t at Karwar, 85 t at Waltair and 14.5 t at Madras at average catch rates of 2.2 kg, 7.9 kg, 24.0 kg, 0.3 kg and 0.1 kg/hr at the above centres respectively. A decreasing trend in production was observed at Cochin, while at Mangalore, Malpe and Karwar the fishery showed improvement over that of the previous year. Peak catches were recorded during December-January on the southwest coast. On the east coast, the most productive seasons were January at Madras and August and January at Waltair. The fishery was supported by a single species, namely *Oratosquilla nepa* along the coasts of Kerala and Karnataka, while on the east coast it was multispecies in character with *O.nepa* (33%) and *O.woodmasoni* (28%) as the dominant species at Madras and *O.interrupta* (42%), *O.nepa* (14.5%) and *O.woodmasoni* (13.8%) at Waltair. Along the southwest coast of India, the major size group of *O.nepa* was 61-115 mm, while on the east coast it was 74-86 mm at Waltair and 50-110 mm at Madras. *O.woodmasoi* was chiefly represented by the size group 60-109 mm. The dominant size of *O.interrupta* was 65-95 mm at Waltair. In all the species females were more in the population.

Field culture of marine prawns (CFCul/1.1.1)

M.S. MUTHU, K.H. MOHAMED, N.N.PILLAI, A. LAXMINARAYANA, S.K. PANDIAN, MARY K. MANISSERI, SYED AHAMAD ALI, A.R. THIRUNAVUK KARASU, M. RAJAMANI, G. NANDAKUMAR, M. KATHIRVEL, K. DEVARAJAN, M. RAJAGOPALAN AND S. LAZARUS

Narakkal: Twentyone experiments were carried out on the culture of *Penaeus indicus* in the grow out ponds at MPHL and in the fields of farmers. The maximum production in the MPHL ponds were 94 kg/ha for a culture period of 58 days; when the stocking rate was 40,000/ha. Experiments with higher stocking density i.e. 100,000/ha yielded 125.0 kg/ha with 32.75% survival within a period of 98 days. In the farmers fields the maximum yield of 297.5 kg/ha was obtained for a period of 52 days with almost cent percent survival at a stocking density of 50,000/ha. In another farmer's field for a higher stocking density of 100,000/ha within 49 days, 325.88 kgs of prawns were harvested with 95.7% recovery. The poor yield in the MPHL ponds could be attributed to the poor soil quality of the pond since these ponds were not completely drained for a few years. Moreover the ponds were infested with *Tilapia* sp which became a competitor for prawns. Steps are being taken to improve the pond conditions.

Calicut: Three sets of experiments were conducted, first from February to May, second from June to September and third one from December onwards. Seeds for the first and third experiments were brought from the Prawn Culture Laboratory at Narakkal and for the second experiment, seeds were collected from the backwater and barmouth areas.

For the first experiment, a total of 9862 seed of *P.indicus* were stocked in four ponds having a total area of about 1500 m^2 at a stocking rate ranging between 5 and 15/m^2. Daily length increment varied

from 1.04 to 1.19 mm. Average weight increment was found to be 0.08 g. Due to old nature of the lining in the ponds leading to seepage of water and subsequent fall in the water level and predation by birds survival and production rates were found to be very low. A maximum production of 177.5 kg/ha for 84 days with a survival rate of 25.4% was obtained from one pond.

A total of 1350 seed of *P.indicus* with a mean size of 27 mm and weight of 0.22 g was stocked in a pond having an area of 135 m^2, for the second experiment. The stock was harvested on the 95th day. Survival rate was 49% and the production rate was 157.4 kg/ha.

In the third experiment, 39,000 seed of *P.indicus* were stocked in seven ponds having 0.3 ha total area under different stocking rates. Compared to other two experiments, survival rate was poor in this experiment.

Madras: During the period under report, monoculture trials of fast growing species namely *P.monodon, P.indicus, P.japonicus* and *P.semisulcatus* were carried out.

In the case of *P.monodon* two types of experiments were carried out, changing the duration of culture periods. For the first set of experiments the duration varied from 5-7 months and for the second set it varied from 67-75 days. The survival rate of *P.monodon*, cultured for longer periods, varied from 20.7 to 27.6 % with growth ranging between 0.66 to 1.1 mm per day. The size of the prawns at harvest varied from 161-188.8 mm. The survival rate of *P.monodon* cultured for short period varied from 17-79.4% with growth rate between 1.57 to 1.63 mm per day. In one experiment the rate of production per ha for 75 days was 96.6 kgs with a survival of 79.4%.

In the case of *P.indicus*, 10 trials were made. The survival varied from 10.7 to 51.5 % with average growth per day varying from 0.5 to 1.8 mm.

Two experiments on polyculture of *P.monodon* and *Chanos chanos* were also carried out. In a 0.15 ha pond, 750 numbers each of *P.monodon* seed reared in the laboratory and *Chanos chanos* from wild were stocked. After 180 days 30.8% of *P.monodon* and 8.4% of fishes were recovered.

Tuticorin: Two experiments were carried out on the field culture of *P.semisulcatus* For the first experiment 1200 postlarvae (7-10 mm) reared in the laboratory were stocked in 0.04 ha pond at the rate of 30,000 numbers/ha. For the second experiment 2439 postlarvae (7-24 mm in total length) were stocked in a 0.25 ha pond, at the rate of 9756 number/ha. They were fed with clam meat and trash fish. From 8.7 mm the prawns had grown to 127 mm in total length within a period of 132 days. The growth rate was 0.9 mm/day.

In another pond of 0.25 ha seed of *P.indicus* collected from the wild were stocked at the rate of 30,300 number/ha. No supplementary feed was given. After a period of 118 days 19.3 kg. of prawns (47% recovery) were harvested. The poor growth rate 0.5 mm/day may be due to the lack of proper food in the ponds.

Mass production of prawn seed (CF/Cul/1.1.2)

K.H. Mohamed, M.S. Muthu, N.N. Pillai, S.K. Pandian, A. Laxminarayana, Mary K. Manisseri, Syed Ahamad Ali, A.R. Thirunavukkarasu, K. Devarajan, M. Kathirvel, and M. Rajamani

Cochin: Techniques for brood stock maintenance and induced maturation were perfected. A series of experiments were carried out on the induced maturation

and spawning of *Penaeus indicus*. Eyestalk of the female specimens of this species were unilaterally ablated. A total of 284 spawnings were obtained. 53 specimens repeatedly matured and spawned after ablation at intervals of 6 to 26 days.

Experiments conducted on the influence of salinity on maturation, indicated that the eye ablated specimens matured in 33 ± 0.5, $23+0.5$ and $19+0.5$ ppt. The latent period increased with decrease in salinity. Experiments conducted also revealed that the number of eggs produced and also the hatching rate decreased with decrease in salinity. Studies on the influence of feed on maturation showed that clam meat is the best for inducing maturity. Experiments conducted on the influence of PH on hatching rate of this species showed that the eggs did not hatch out in pH 9. The hatching rate was 48% in 8.5, 97.3% in 8.2, 84.7% in 8.0, 50.7% in 7.5 and 42.7% in 7 pH respectively.

Specimens of *Penaeus indicus* were induced to mature and spawn in the laboratory, as and when they were required for the experimental work at the Marine Prawn Hatchery Laboratory (MPHL) at Narakkal. Thus during this period, 92% of the requirement of spanwers of *P.indicus* was met from the maturation pools kept in this laboratory.

Experiments were carried out to simplify the hatchery and nursery technologies, with a view to bringing down the cost of production of postlarvae and early juveniles of *P.indicus*.

In the previous years, 1/3 to 1/4 of seawater from the larval rearing pools (2 ton capacity) was regularly reduced and replaced with fresh filtered seawater from protozoea II stage onwards. The investigations carried out during this period revealed that nauplii could be released in rearing pool containing 1/4 seawater and the level raised slowly within a period of 5-6 days to the maximum, when the larvae reached Mysis II and III stages. Water changing (1/3 to 1/4) was carried out only when the larvae reach Mysis II and III. Thus the experiments showed that the quantity of seawater daily used in the rearing pools could be considerably reduced, which will bring down the cost of production of postlarvae.

The efficiency of different feed combinations for the rearing of larvae of *P.indicus* upto postlarva I (PL I) was investigated. Three different larval feeds viz: (i) mixed culture of phytoplankton dominated by *Chaetoceros* sp; (ii) mixed phytoplankton culture with micro particulated artificial diet and (iii) mixed phytoplankton with squilla powder, were tried. The average survival of larvae in these experiments were 26.1%, 25.5% and 27.4% respectively. The fact that the larvae could be grown on a mixed phytoplankton culture dominated by *Chaetoceros* sp which could be maintained easily and without much expenditure in our conditions, showed beyond doubt that particulate feed can be avoided for the rearing of larvae upto PL1.

4. 017 million postlarvae (PL5) were produced from 14.104 million nauplii, the average survival rate being 28.48%.

Postlarvae I were transferred to nursery tanks (4 and 12 ton capacity rectangular cement tanks and 10 ton capacity circular pools). They were retained in seawater upto PL 5 stage and fed with micro particulate artificial feed. After PL 5, the postlarvae were slowly acclimatised to brackishwater and fed with granulated artificial diet. Both these diets were tested in the laboratory and found to be good for the rearing of larvae from PL1, to PL 20 stages. 1.7 million seed of *P.indicus* were produced and were supplied to the

co-operative prawn culture farms (under Lab to Land programme), 19 local farmers who were willing to conduct scientific prawn farming under the guidance of CMFRI, Marine Products Export Development Authority and to the Research Scholars of CAS in Mariculture. In addition, experimental farms of CMFRI at Narakkal and Calicut were also stocked with prawn seed produced from this unit.

During the last quarter of this period, four *P.monodon* after eyestalk ablation, matured and spawned in the laboratory; 2.25 lakhs of nauplii were obtained. They were reared to PL1 using mixed phytoplankton culture as food.

Fully mature *Metapenaeus dobsoni* collected from the brackishwater pond, where the salinity of the water was only 19 PPt spawned and the larvae were reared in the same water upto the postlarval stage. Spawning and rearing of this species in water of 19 ppt salinity is a new record.

Experiments were also carried out on the intensive culture of live feed organisms such as *Artemia,* rotifers and *Moina.* Nine experiments were carried out in *Artemia* biomass production using Great Salt Lake and Tuticorin strains. All the experiments were carried out with normal sea water in one ton tanks. Different types of feed such as mixed phytoplankton culture, rice bran, yeast and ground nut oil cake were tried at different stages. The maximum biomass production obtained was 400 gm per ton of water in eleven culture days with a stocking density of 149 nauplii per litre and a survival of 39.1%. Two experiments were carried out on mass culture of rotifers. Totally 148.4 million rotifers were produced and utilized for penaeid postlarval feeding. *Moina* was cultured in a 2-tonne capacity plastic pool. Initial fertilization was done with groundnut oil cake at the rate of 300 g/ton of water. *Moina* was stocked at the rate of 6 numbers per litre. A good bloom of *Chlorella* was developed. When the population reached 3200 *Moina* per litre on the 13 day, partial harvesting started. Totally 18.22 million *Moina* were harvested and used for penaeid postlarval feeding.

Madras: During this period, 35 experiments were carried out on the mass production of postlarvae of *P.monodon, P.indicus* and *P.semisulcatus.* Whenever the temperature was below 28°C, the duration of larval development for all these species increased from 11-12 to 15-16 days. 1.24 lakhs of PL1 of *P.monodon* were produced and they were further reared for 17-30 days and utilised for conducting field culture experiments in the departmental farm at Muttukadu. 3.82 lakhs PL1 of *P.indicus* were produced, from which 89,788 PL 14-40 were reared and stocked at the experimental ponds at Muttukadu. A single experiment conducted on the rearing of larvae of *P.semisulcatus* yielded 41,277 PL1. They were reared for 14 days and 30,600 PL 14 were used for conducting trials at the departmental culture ponds.

Tuticorin: Experiments were carried out to induce maturity in the laboratory reared and cultured *P.semisulcatus* by unilateral eyestalk ablation.

Artificial propagation of green crabs (CF/Cul/1.1.3)

R. MARICHAMY

Culture experiments: Seeds of *Scylla serrata,* in the size range 20-35 mm CW were collected from mud flats in the harbour area and Pinnakayal backwater. They were released in pond B together with *Chanos chanos* in June '83. Due to adverse hydrological conditions such as increasing salinity in the rearing pond, the crabs were harvested by the end of September

1983. The size of the crabs at harvest was 103 mm/185 g indicating, a growth rate of 23.3 mm/54.8 g/month. 30% of the stock survived and the production worked out only to 495 kg. due to early termination of the experiment. The water in the pond was drained completely and the site cleared for subsequent stocking operations. The second experiment was started by the middle of November 1983. When the ecological conditions were favourable in the pond hatchery produced seeds in the size 31-60 mm were stocked in pond B and they have grown to 131 mm/282 g on 20-3-'84, revealing the growth rate of 23 mm/64 g/month. This stock is continuing to grow in pond B.

Induced maturation and spawning: Eye-ablated crabs died after 2 weeks interval or remained without any progress. The berried crabs, after successful hatching out of zoea were kept in aquarium tanks to observe further spawning in laboratory. Although the animals were kept for more than 5 months, none of them have spawned in existing conditions.

Larval rearing: Berried females were available almost round the year from fishing grounds off Kayalpatinam. The mother crabs were fed with clam and prawn meat. The zoea hatched in the morning between 0500-0600 hrs. 20 experiments were conducted during the year and steady progress in the production of crab seed was attained from experiment to experiment. The following are the conclusions drawn from these experiments.

1. The incubation period varied from 7 to 12 days.

2. 1.5 to 2 million zoea larvae were produced by crabs with a size of 135-148 mm CW. Ovigerous females without chelate legs yielded incomplete hatching of zoea.

3. The five zoeal stages take 16-29 days and one megalopa stage lasts for 8-10 days and the first crab instar is reached on 26th-30th day after hatching.

4. Better survival was noticed in 30-33 ppt salinity and the most suitable range of temperature was 26-30°C. The higher the temperature, the quicker the growth rate or metamorphosis. Temperature has a significant role in the development and survival of larvae.

5. A wide variation in the pattern of of chromatophores on the carapace was noticed in young crabs upto the 7th instar.

6. *Chlorella* fed rotifers were supplied as food for the early stages upto zoea III. Artemia nauplii were the ideal food for later stages. Live copepods were given from megalopa stage onwards in addition to the macerated prawn and clam meat.

7. Heavy mortality of zoea was noticed in the 2nd and 5th zoes stagea. Cannibalism was noticed from megalopa stage onwards. Segregation of the carnivorous megalopa resulted in good production of young crabs.

8. Growth process was quick in advanced stages of zoea when reared in low saline water (23-25 ppt.). The duration of the megalopa stage can be shortened by culturing in such media.

9. Improvements in rearing tank structure were designed for scaling up the hatchery operations.

Design of low cost prawn hatchery for prawns (CF/Cul/1.1.4)

K.H. Mohamed and M.S. Muthu

The hatchery is now being constructed by the CPWD and is expected to be completed later this year.

Artificial insemination and breeding of prawns (CF/Cul/1.1.5)

M.S. Muthu, K.H. Mohamed and A. Laxminarayana

For the first time viable nauplii of the Tiger prawn *Penaeus monopon* have been produced by artificial insemination. A technique of implanting electroejaculated spermatophores from the males into the thelycum of newly moulted, eye ablated females was perfected.

Adult specimens of *P. monodon* were collected from the sea as well as from the brackishwater ponds at Narakkal. Three immature adult females were subjected to unilateral eyestalk ablation using an electrocautery apparatus and were kept individually in circular plastic lined pools containing 250 litres of filtered seawater. The prawns were fed with clam meat daily. Daily, the water was changed and fresh filtered seawater added. Water was well aerated. Temperature in the pools varied from 28.5°C to 30-5°C, the salinity from 32.0 to 33.5 ppt and the pH 8.1-8.2. Whenever the female moulted, the spermatophores storeed in the thelycum were lost along with the moulted cuticle. The female was then artificially inseminated with spermatophores extracted from a male by electroejaculation. Thus all the females were implanted with a fresh set of spermatophores after each moult. Every implantation was followed by a spawning 7 to 15 days later. Totally there were 10 spawnings which yielded 1,930,800 eggs. However the hatching rate was low (2.4%). From the 4th spawning of a female of 264 mm, 1686 viable nauplii were obtained. Experiments were conducted using these nauplii. These nauplii were found to be healthy and they metamorphosed to healthy post-larvae I. The present work has opened new vistas in selective breeding and genetic manipulation of commercially important species. The technique will be invaluable for future work in hybridization of penaeid prawns.

Feed development for intensive culture of marine prawns (CF/Cul/1.1.6)

Syed Ahamed Ali, Mary K. Manisseri, K.H. Mohamed and M. Vijayakumaran

The suitability of *Rhizophora* leaf (mangrove plant), rice bran, wheat bran, wheat flour, maize and jowar, as feed ingredients for prawns was tested. The prawn feed NPCL/235, developed at Prawn Culture Laboratory of CMFRI, Narakkal, which consisted of a feed base (made up of mantis shrimp 25%, prawn waste 25%, groundnut cake 30% and fish meal 10%), tapioca and fish oil, was used for this purpose. Six different feeds were formulated by substituting *Rhizophora* leaves, rice and wheat bran at 5% level each in the feed NPCL/235, partially replacing groundnut cake and fish meal, while maize, wheat flour and jowar were substituted at 20% level each, totally replacing groundnut cake and fishmeal. The pelletized feeds were separately fed to juvenile *Penaeus indicus* in replicated feeding experiments in the laboratory. The growth and food conversion efficiency of the prawns fed with feeds substituted with different test ingredients were marginally less compared to that of the control feed NPCL/235. Substitution of test ingredients in the control feed lowered the protein content of the feed which was mainly responsible for lowering the performance of the feed. However the results had indicated that if the protein content of feed could be maintained by any other means, some of the test ingredients especially wheat flour, maize, jowar and wheat bran could successfully be utilized as energy sources in the prawn feed. The results also indicated

that total replacement of fish oil with tapioca to maintain the calorific value in the feed NPCL/235 was not desirable.

At the Kovalam (Madras) laboratory of CMFRI, six feeds were formulated using crab meal, mantis shrimp, prawn waste, tapioca, vitamins and minerals and tested for rearing postlarvae of *Penaeus indicus*, *P.monodon* and *P.semisulcatus*. Using these feeds the postlarvae could be reared for a period of 51 days with a survival rate ranging from 46.3% to 66%. The increase in total length was 35mm during this rearing period. A feed consisting of crab meal 50%, prawn waste 17%, tapioca 32% and vitamins and minerals 0.3% was formulated for rearing larvae of *P.indicus* in open tank culture experiments. A survival of 38% from nauplius to postlarvae I could be obtained using this feed.

Culture of Spiny lobsters (Panulirus sp.) (CF/Cul/1.5)

E.V. RADHAKRISHNAN, M. VIJAYAKUMARAN

Experiments with ablated *Panulirus homarus* fed with 3 types of food viz clam, mussel, fish and a mixture of these showed that mussel was the best food, followed by mixed diet, clam and fish in that order. When the lobsters were fed with mussel the intermoult period was reduced (i. e. the moulting frequency was increased) they consumed more quantity of food, the food conversion ratio was the lowest and the weight gain was maximum. Further the lobsters fed on mussels maintain their natural colour while those fed on clams and fish develop paleness resulting in albino lobsters. Mussel which grow on rocks among which the lobsters live is the natural food of these animals. So while culturing them they should be fed with mussel to get the best results. If fed with fish or other food the diet should at least be supplemented with mussel meat.

Eye ablated *P.homarus* could mate normally and produce fertilized eggs. Continuous spawning was noticed in groups of eye ablated lobsters kept in a large circular cement tank. But in some lobsters eyestalk ablation led to resorption of ovary leading to pink colouration of the haemolymph.

Experiments on the growth of eye ablated and normal lobsters were conducted on *P.ornatus*, *P.polyphagus* and *P.versicolar*. In all these species eyestalk ablation led to increased moulting frequency, shortening of the intermoult period and tremendous increase in weight, compared to the control animals. In *P.ornatus* the ratio weight gain in ablated animals/wt. gain in control animals was 10.0, 23.5 and 41.4 in animals with initial average weight of 140 g, 700 g and 1500 g respectively. In *P.polyphagus* this ratio was 5.1 for animals with an initial weight of 195 g.

The eye ablated lobsters were very sensitive to low oxygen levels and died when aeration was affected due to current failure.

MOLLUSCAN FISHERIES DIVISION

Following the breakthrough in the development of hatchery technology for pearl oyster seed production in the previous year, techniques for production of edible oyster seed under experimental hatchery conditions were successfully developed during 1983-84. Accelerated programme was taken up for seed production of the two species of sea mussel.

The research projects completed by the end of 1982-83 were (1) MOL/RE/1.1 - Resources survey of commercially important molluscs and (2) MOL/Cul/1.7 - Development of hatchery system for pearl oyster seed production. Two projects, MOL/CUL/1.4.1 and 1.4.2, were merged with the major project MOL/CUL/1.4 - Pearl Culture. During 1983-84, three new projects were included. These are MOL/RE/1.9 - Atlas of clam resources of Kerala and Karnataka; MOL/CUL/1.7.1 - Experimental pearl oyster hatchery for mass production of spat; and MOL/CUL/1.10 - Breeding and experimental sea-ranching of commercially important gastropods. In all, the Molluscan Fisheries Division implemented seven projects under "Molluscan Fishery Resources" programmes 11 projects under "Mariculture - Culture of Molluscs" programme, one project under Inter-Institutional Projects and four projects under Technology Transfer - Training programmes, totalling 23 projects.

Survey of cephalopod resources in Exclusive Economic Zone (MOL/RE/1.2.1)

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R.V. Skipjack caught about 100 juveniles of oceanic squid, 12-34 mm in DML, in June 1983 in the north-eastern Bay of Bengal at 20–40' N and 88–53'E at a depth of 40 m. The vessel also landed small quantities of *Loligo duvaucelii, Sepia aculeata* and *Sepiella inermis* in 20-76 m depth range.

The Govt. of India vessels in the Exploratory Fisheries and Integrated Fisheries projects landed about 20 t of cephalopods. The chartered fishing vessels concentrated on cephalopods as one of the prime resources and 17 such vessel caught 1704 t of cephalopods which accounted for about 9% of annual cephalopod landings of the country. Samples indicated predominance of *Sepia pharaonis*.

Three trawlers of the EFP, operating bottom trawl, from Bombay base, caught about 12 t of cephalopods at the rate of 4.8 kg/hr. The area 17-72 yielded better catches, the yields ranging between 7.3 kg/hr and 12.3 kg/hr. The other areas surveyed were 17-73, 18-71, 18-72, 19-71, 19-72 and 20-72. Six vessels of IFP and two vessels of EFP operating from Cochin base caught 2.8 t of cephalopods in bottom trawl nets from areas 9-76, 9-75, 8-76, 7-77, 10-75 and 10-76. The area 7-77 yielded 11.2 kg/hr. The depth ranged between 18-66 m. This group was scarce in pelagic trawl and mid water trawl. From Tuticorin base one trawler of EFP operating in the area between Manapad and Vizhinjam caught about 1.8 t of cephalopods, mostly cuttlefishes, during October-March in the depth range of 100-200 m. About 47% of the catch was obtained in March '84. Four trawlers of EFP at Madras base caught 0.4 t of cephalopods in bottom trawl nets at the rate of 1.9 kg/hr during April-September. A catch rate of 6.5 kg/hr was obtained in April '83. Better catches were obtained from areas 13-80, 14-80 and 15-80. From Visakhapatnam base, one vessel operating bottom trawl caught 0.3 t of cephalopods at the rate of 0.7 kg/hr.

Stock assessment of cephalopod resources of the inshore waters (MOL/RE/1.2.2.)

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The estimated production of squids and cuttlefishes from the Indian seas showed an increase of about 1557 t, from 17,016 t in 1982-83 to 18,573 t in 1983-84. Maharashtra (37% and Gujarat (20%) contributed to the bulk of the catch. Landings in Kerala showed about 48% decrease. Veraval showed about 205% increase and Bombay 43% increase over 1982-83. Mangalore and Visakhapatnam centres showed marginal increases. Cochin and Vizhinjam and Madras centres showed a decline of 208%, 24% and 18% respectively.

Data collection for stock assessment of cephalopods of the inshore waters was continued from different centres. The production estimates, catch per unit of effort, species composition and size ranges relating to landings as by-catch by shrimp trawlers are given in Table 1. At Vizhinjam 95.2 t of cephalopods were caght in hooks and lines (66%), boat seines (32%) and shore-seines (2%), showing a decline of 24% from the landings of 1982-83. The species composition included *Doryteuthis* sp. (43%), *S.pharaonis* (28%), *L.duvaucelii* and *Loligo* spp. At Bombay New Ferry Wharf, the catch rates ranged from 2.6 kg/unit in August to 700 kg/unit in December with an annual average of 126.2 kg/unit. At Sasoon Docks the CPUE ranged from 2.85 kg. in July to 660.3 kg in December with an annual average of 123.9 kg/unit. At Veraval the catch rates ranged from 1.3 kg/unit (June) to 200.7 kg/unit (October). In the above centres cephalopods accounted for from less than 1% to as high as 40% of the total landings. At Bombay and Veraval squids and cuttlefishes were landed in good quantities throughout the year except during monsoon months. At Mangalore also the same trend was seen but there was no fishing during July-October. Cochin recorded better catches during April-May and July; Vizhinjam during

Table : 11

Estimated cephalopod landings by the shrimp trawlers at different centres during 1983-84

Centres	Total cephalopod landings (t)	CPUE kg/ Unit	*L.duvaucelii* %	Size range (mm)	*S.aculeata* %	Size range (mm)	*S.pharaonis* %	Size range (mm)	*S.elliptica* %	Size range (mm)	Others %	% of cephalopods in all fish catch
Veraval	2568	585	51.2	20–289	0.1	—	—	—	47.4	15–149	1.3	4.7
Bombay New Ferry Wharf	3060	126.2	42.5	30–270	35.2	40–229	22.2	160–349	—	—	0.1	7.3
Bombay Sasoon Dock	2275	123.9	50.0	40–225	49.4	90–180	—	—	—	—	0.6	9.8
Mangalore	516	13.0	73.2	30–249	22.6	50–209	—	—	—	—	4.2	3.2
Cochin	46	1.0	51.9	50–250	1.4	60–150	25.2	100–220	3.3	50–100	18.2	0.5
Tuticorin	8	0.3	49.0	50–200	9.0	60–140	35.1	50–300	5.1	50–140	1.8	0.2
Madras	440	14.6	19.0	40–160	45.1	50–180	26.1	30–260	—	—	9.8	4.5
Visakhapatanam	239	—	46.2	50–259	17.5	50–229	24.4	50–269	—	—	11.9	—

September-December; Madras during January-September; and Visakhapatnam during April-May and July-October. Mature squids and cuttlefishes were observed in good numbers in the catches in Bombay and Vizhinjam. Immature ones were dominant at Cochin, Tuticorin and Visakhapatnam. At Mangalore immature squids and mature cuttlefishes were dominant.

Genetic resources of commercially important molluscs (MOL/RE/1.5)

K. ALAGARSWAMI AND M.M. MEIYAPPAN

Electrophoretic studies on the protein pattern of *Meretrix casta* from Porto Novo were completed. A comparison of these results with those of the same species from Cochin showed very little differences in protein pattern.

Assessment of exploited mussel resources (MOL/RE/1.6)

P.S. KURIAKOSE AND K.K. APPUKUTTAN

The standing stock of brown mussel *Perna indica* along the south-west coast (Cape Comorin to Quilon) was estimated to be 1610 t. Spat settlement started during September-October 1983 and was better compared to the previous year. The spat density (size 15-20 mm) ranged 8000-9000 spat/sq.m. An estimated 556.2 t of brown mussel was landed in the region during the period October-March, as compared to 208.9 t during 1982-83. The market price range was Rs. 2-8/100 mussels.

The landings of green mussel *P.viridis* along the Malabar coast from Challium near Beypore to Koduvaly near Cannanore were estimated to be 2596.7 t as compared to 3074 t during 1982-83. The centre-wise production was as follows: Challium – 850.0 t; Elathur–249.2 t; Moodadi & Thikkodi–720.0 t; Chombala–271.4 t; Mahe–135.0 t and Koduvally–371.2 t.

Spat settlement was noticeably absent on the intertidal areas, but was moderate at a density range of 1547-3597 spat/sq.m on the submerged rocks since September. The size range of spat was 12-40 mm. The density of adult population (40-120 mm) was 265-605 no./sq.m. Along the Uttar Kannada coast, there was no mussel fishery. Spat settlement was noticed only at Harwada and Tadri at a density of 5825 spat/sq.m over a small patch of about 100 sq.m.

Experiments in transport of molluscan seed (MOL/RE/1.7)

S. MAHADEVAN, P. MUTHIAH, K.K. APPUKUTTAN

Behaviour of molluscan seed under experimental conditions was studied. The hardened seed of edible oyster withstood adverse conditions better with a mortality rate as low as 9%.

Recruitment studies in clam population (MOL/RE/1.8)

K.A. NARASIMHAM AND N. RAMACHANDRAN

In Kakinada Bay, *Anadara granosa* measuring 3-7 mm (seed) occurred throughout the year. The recruitment to the clam fishery takes place mainly during March-May when the population density is more than 10 clams/m^2. The maximum size of *A.granosa* in the fishery was 63 mm. Environmental parameters including nutrients and organic carbon were collected from *Anadara* beds. In Kali estuary (Karwar), work on three species of clams was carried out. For *Meretrix casta*, population density range was 2-104 clams/m^2 (maximum in May) and the size range was. 20-32 mm. In the case of *M.meretrix* the density was less than 14 clams/m^2 and the size range was 20-51 mm. Small clams (*Meretrix* spp) measuring less than 20 mm occurred in density ranging from 4 clams/m^2 in October to 382 clams/m^2 in May. Seed clams of *Villorita cyprinoides*, 3-9 mm size, occurred during June and October-March with a peak during November-January.

Atlas of clam resources of Kerala & Karnataka (MOL/RE/1.9)

G.P. KUMARASWAMY ACHARI, K.K. APPUKUTTAN, K. PRABHAKARAN NAIR, G. SYDA RAO, P.S. KURIAKOSE AND N. RAMACHANDRAN

The project was initiated during this year to study in detail the clam resources and their exploitation in the estuaries of the States of Kerala and Karnataka and to bring out an atlas with all details for use in exploitation and management of these important resources which support a subsistence fishery for fishermen at many centres. Survey of eight estuaries from Poovar to Kayamkulam in Kerala was completed. While *Meretrix casta* and *Villorita cyprinoides* are the common species in all these estuaries, *Katelysia opima* along with *Paphia* sp. and *M.casta* are found in Ashtamudi and Kayamkulam estuaries. *Villorita* production in Vembanad lake was estimated at 17,699 t. The mass mortality of clams in this estuary in May-June was investigated. In the Mulki estuary, clam landings were estimated at 3110 t of which *M.casta's* contribution was 2359 t and *Paphia malabarica's* was 751 t. In Kali estuary, clam landings were estimated at 41 t and in Aghanashini estuary at 301 t. The survey was continued beyond March 1984 for completing the work in other estuaries.

Culture of edible oysters (MOL/CUL/1.1)

K. NAGAPPAN NAYAR, K. SATYNARAYANA RAO, P. MUTHIAH AND M.E. RAJAPANDIAN

For the experimental collection of spat of *Crassostrea madrasensis*, 25,000 lime coated tiles, 300 rens, 30 frames with velon screen and 20 frames with polythene sheet placed in trays were employed. A total of 89,000 oyster spat have been collected.

The spat density was 6/shell, 15/tile and 12-30/ velon screen or polythene bag unit. About 49,000 spat were broadcast in Korampallam creek area and the rest were used for tray culture in Tuticorin Bay for the grow-out culture phase. Spat produced in the hatchery registered a growth rate of 10.2 mm/month.

About one tonne of oyster meat was harvested from the oyster farm and supplied to the Government of India Integrated Fisheries Project, Cochin for product development and experimental marketing.

Experiments on fattening of oyster were carried out using *Chlorella* as food. Mass culture of *Chlorella* was done using urea at 10 mg/l; NPK 21.0.0 at 100 mg/l and NPK 16.20.0 at 10 mg/l. Dense blooms of *Chlorella* with a high density of 8.6 million cells/ml were obtained on the third day after inoculation. Salinity tolerance tests were conducted in the range of 5-60 ppt. At 5 ppt, mortality was 65 % on day 6 and 100% on day 9. At 60 ppt, mortality was 80% on day 2 and 100 % on day 4.

The sex ratio of *Crassostrea madrasensis* was equal in February and April while females were dominant (52-70%) in most of the other months. Spawning took place during March-April with a secondary spawning in August. Parasitisation by cercaria of the trematode *Bucephalopsis* sp. was noticed in 35% of oysters in November, 14.3% in December and 20% in January. Spirochaete infestation was 32% in January and 20% in February and March. The parasites were found in the gonad, gills, labial palps, digestive gland and mantle of the oyster.

Culture of mussels (MOL/CUL/1.2)

K. Rangarajan, K.K. Appukuttan, P.S. Kuriakose and N. Ramachandran

The experiment on culture of green mussel *Perna viridis* in the salt water lagoon at Muttukadu near Madras was intensified. At a depth of 2.0-2.5 m, poles were erected in the lagoon and mussel seed of 20-25 mm size collected from the natural bed at Ennore were used for seeding. The seed were bagged in tubular cotton netting material at 2 kg/bag and wound on the poles. The growth rate of about 11 mm/ month was obtained. The maximum size at harvest was 82 mm and 46 g and the mean size was 60-64 mm at the end of 5 months of culture duration. A harvest of 434 kg was taken in May. The average production per pole was 4.82 kg, with the maximum of 7.0 kg/pole. The flesh content of mussel ranged 33.3-45.0%. The mussel population was all male at harvest time, although at seeding the sex ratio was almost equal. Culture commenced in July proved a failure due to inadequate seed availability and damage by turtles in the lagoon. Work was again started in November 1983 and by end of March 1984, mussel had reached a size of 63 mm.

At Karwar, the programme was on a very low level due to non-availability of enough mussel seed in the region. Seed collected from exposed intertidal rocks and attached to ropes had slipped and were lost. The seed transplanted in December 1982 had grown to an average size of 69.3 mm in July 1983, but the stock was lost under monsoon conditions.

At Vizhinjam, the mussel spat seeded in November showed large-scale slipping, whereas those collected and seeded in December remained on the ropes. The growth rate was poor as compared to previous years. Predation of farm mussel by fish *Tetradon* was observed in January.

Cutlure of clams and windowpane oyster (MOL/CUL/1.3)

K.A. NARASIMHAM, G. SYDA RAO AND N. RAMACHANDRAN

The work on clam culture could not make the desired progress for want of controlled farm facilities. Windowpane oyster culture could not be taken up for want of seed. The seed density in the Kakinada Bay was less than 5/m^2. *Meretrix casta* stocked in Mulki-estuary showed poor growth due to periodic exposure and growth was only 15 mm in 15 months. In pen-culture of the same species at density of 350 clams/m^2, the clams had grown from 20 mm in December to 29 mm in March. In Karwar, biological studies on *M.casta* were carried out.

Replenishment and monitoring of Villorita spp. production in estuarine system (MOL/CUL/1.3.1)

G.P. KUMARASWAMY ACHARY

The exploitation of *Villorita* spp. in Vembanad Lake was monitored. During the year, the clam production was 16,622 t as against 19,077 t during the year 1982. The zone-wise production (details of zones in previous report) in 1983-84 was 4409 t, 4829 t, 3961 t and 3423 t in zones I-IV respectively. Production in the zones III & IV south of Thanneermukkom bund was affected by highly acidic condition of the water. In zone-I smaller size groups (less than 10 mm) accounted for 3552 t out of the total 4409 t. Harvest of these sizes is affecting the commercial value of the resource in zone-I. Size regulation is called for in this zone. The high acidic condition and resultant clam mortality in zones III and IV during May-June 1983 appeared to have been a temporary phenomenon as the clam population had revived during July-October yielding to harvest. A clam trawl net has been designed for clam collection from the deeper parts of the lake and awaits trials.

Pearl culture (MOL/CUL/1.4)

K. ALAGARSWAMI, A. CHELLAM, S. DHARMARAJ AND T. S. VELAYUDHAN

The survey trips to monitor the natural population in the pearl oyster beds of Gulf of Mannar were few as the boat was under repair most part of the survey period, Six sea trips made to Nagarai, Kurichan, Devi and Fernando paars yielded only 315 pearl oysters indicating the low productivity of these natural beds. The weaving mussel spread on the beds was extensive which could be one of the reasons for the poor stock position. Pearl oyster farming in the harbour basin was continued with the earlier stocks and hatchery produced oysters. Growth and reproductive potential of oysters grown on the harbour breakwater slope were found to have been affected and it has become increasingly evident that the breakwater area is not ideal for maintenance of oyster stocks. However, in raft culture, suspending the oysters at 5 m depth, continued to give satisfactory results. The rate of growth of oyster was 2.4-7.1 mm/month on the slope and 3.4-12.5 mm/month at 5 m depth. A collapsible raft of 15 x 15 m was tested at Veppalodai and a raft with FRP-floats fabricated at the Vikram Sarabhai Space Centre under the inter-institutional project was tested in the harbour basin farm.

Monitoring the reproductive cycle of pearl oyster, differences were observed in the percentage of population in different reproductive phases in different months among oysters grown on the breakwater slope, in surface waters and at 5 m depth. This resulted in spawning during different periods without synchrony. The data indicate the role of environmental parameters in influencing the reproductive cycle at the microlevel within the same ecosystem Panel studies on foulting confirmed minimal fouling at 5 m depth which led to the decision to grow oysters at this depth. Pearl oyster surgery work aimed at improving

the production rate and quality could be done only on a very modest scale.

Development of shell-bead nuclei for pearl culture (MOL/CUL/1.4.3)

K. ALAGARSWAMI AND B.S. RAMACHANDRUDU

The machines required for shell cutting and sphere grinding had been assembled and trials taken. Production rate was found to be very low under the set up at 50 beads/day. Polishing was attempted using acid medium and washed with washing soda solution. Reviewing the progress made by the project, it was found that external engineering assistance would be required for improving production rate and for achieving required dimensional accuracy and polishing. It was decided to terminate the project and refer the requirement to the Indian Institute of Technology.

Development of hatchery system for edible oyster seed production (MOL/CUL/1.5)

K. NAGAPPAN NAYAR, K. SATYANARAYANA RAO AND M.E. RAJAPANDIAN

Broodstock of *Crassostrea madrasensis* was maintained in the laboratory. Twenty-one experiments on oyster breeding were carried out and eight were successful resulting in spat production. The larval phase extended from 18 to 24 days from spawning. Spat production in the 8 batches varied from 75 to 49,000. Microalgal species *Isochrysis galbana*, *Pavlova* sp., *Dicrateria* sp. and *Chromulina* sp. were used as larval food. Experiments on induced maturation of oyster were carried out using diets of *Chlorella*, mixed phytoplankton and corn flour. Oysters fed on mixed phytoplankton attained maturity in 15-28 days and spawned during May-June, September and November.

Development of hatchery system for mussel seed production (MOL/CUL/1.6)

K. RANGARAJAN AND K.K. APPUKUTTAN

Success was achieved for the first time in rearing the larvae of green mussel *Perna viridis* and brown mussel *P.indica* to spat stage. In the Kovalam laboratory, ripe *P.viridis* was spawned by thermal stimulation. The larvae were reared on a diet of *Isochrysis galbana* or *Pavlova* sp. Reaching a size of 280-300 microns on day-15, spat setting commenced on the 16th day from spawning. Spat settled on different cultch materials provided in the rearing tanks and intense spatfall was observed on glass-wool and ceramic tile. In one month the spat measured 1.25-1.50 mm and in two months 10 mm. Over 10,000 spat were produced in one of the three successful rearings. Similar success was achieved in *P.indica* in the Vizhinjam laboratory. Larval feeding was done with *I.galbana* and *Pavlova*. Spat setting was observed on day-21. The experiments were being intensified to standardise the basic hatchery techniques for mussel seed production.

Experimental pearl oyster hatchery for mass production of spat (MOL/CUL/1.7.1)

K. ALAGARSWAMI, S. DHARMARAJ, A. CHELLAM AND T.S. VELAYUDHAN

Growth of pearl oyster *Pinctada fucata*, produced in experimental hatchery during 1981 and 1982 and transplanted in the farm, was monitored. The growth in 2 years 3 months was 61.6-64.2 mm and in 1 year 3 months 44.0 mm. For the first time direct evidence on the growth rate of the Indian pearl oyster was obtained under farming conditions. Considerable improvements were made in juvenile rearing (3-25 mm size) using lantern-type velon-screen covered nets. During the year, 9 larval rearing experiments were carried out for determining optinum larval density, usefulness of different species of microalgae as larval food and algal cell concentration. In experiment 1, over 100,000 spat were

produced with a spat production rate of 10%. Experiments 2 and 3 were not successful due to high ambient salinity (37 ppt). In experiment 4, using hatchery-produced oysters as broodstock, larval density of 2/ml gave the spat production rate of 8.0%. In the salinity range of 29-33 ppt, 31 ppt gave better production. In the other experiments local species of microalgae were tried as larval food and, except *Dunaliella*, others gave good results. A high 24.0% spat production rate was achieved with *Pavlova* as food. For induced maturation, mixed phytoplankton, *Chlorella*, rice flour and corn flour were used as diets. The results showed that pearl oysters in indeterminate stage could be induced to mature, and those in the maturing stage to ripen through feed manipulation.

Development of hatchery system for clam seed production (MOL/CUL/1.9)

K.A. NARASIMHAM

Through gonad stripping, gametes of blood clam *Anadara granosa* were obtained and fertilised. Larval rearing was not successful beyond straight-hinge stage. Algal cultures were developed for larval feeding.

Breeding and experimental sea ranching of commercially important gastropods (MOL/CUL/1.10)

S. MAHADEVAN, K.K. APPUKUTTAN AND K. RAMA DOSS

Gastropods *Turbo* sp., *Trochus* sp. and *Thais* spp. were collected regularly for observing the natural cycle of reproduction and breeding habits in the species. Steps were taken to collect egg masses of the gastropods for observations on hatching and larval development.

Training in pearl culture (CMFRI/TR/2)

K. ALAGARSWAMI, A. CHELLAM, S. DHARMARAJ AND T.S. VELAYUDHAN

A two-week refresher training course was organised from 25 June to 9 July 1983 for a nominee (Shri M.C. Muthukoya, Fisheries Officer) of the Department of Fisheries, Lakshadweep Administration. The curriculum included intensive practical training in pearl oyster surgery.

FISHERY ENVIRONMENT MANAGEMENT DIVISION

Physical and chemical aspects of the waters of the Exclusive Economic Zone (MBO/ES1.1.)

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The fishery oceanographic investigations were carried out from six Centres *viz*. Cochin, Vizhinjam, Tuticorin, Mandapam, Madras and Kakinada. Most of the observations were from the inshore waters and the sampling was carried out by using medium boats or hired crafts.

The oceanographic group also observed a highly dangerous fishing operation being carried out in the Madras harbour region in October 1983. Highly toxic, chemical mixture was bundled in gunny bags and dipped twice or thrice in the sea upto the bottom when demersal fishes from rocky substratum struggled to come up. The toxic chemical was found to contain cyanide, lead, sodium carbonate and the Institute took up follow up action to stop this highly dangerous practice of fishing by informing the authorities of the Madras State Fisheries.

Cochin: The regular weekly observations revealed the following characteristics of the waters off Cochin. The summer temperature values of the waters were very high. Values as high as 32° C were observed at the surface layers of the coastal waters (10 m depth) off Cochin. A vertically isothermal water column was evident in the region. From the later part of April to the middle of May 1983 the average surface salinity was as high as 36.8°C. Such conditions of high temperature and high salinity continued until the early part of June. The effect of southwest monsoon could be observed by middle of June when the bottom temperature at 10 m station was reduced to 25.3°C. The surface temperature also has decreased and the maximum for June was only 28.5°C. Although the surface salinity values have decreased due to freshwater influx, the bottom values were comparable to those of early June. Conspicuous monsoon upwelling was noticeable only during late July, when the bottom temperature at the 10 m station was reduced to nearly 22°C, a decrease of nearly 7°C compared to the previous summer values. Surface dilution by freshwater influx from land and rains was quite drastic during July, when the surface salinity was reduced to nearly 19‰, a decrease of nearly 17‰ compared to the previous summer. The dissolved oxygen content at the bottom was also low, with a range of 0.3-0.6 ml/L during peak monsoon.

Thus the southwest monsoon was weak during the year under consideration and by August 1983 the conspicuous features in the waters off Cochin began to disappear. By mid August the bottom temperature values have gone upto 23-24°C and by late August the values were nearly 25°C at the 10 m station. This indicated the dissipating nature of the upwelling phenomenon during this year, at an earlier stage than usual. The presence of low salinity waters at the surface layers during winter was observed during December. During February and March the dissolved oxygen content was higher at the 10 and 20 m stations, than in January.

Vizhinjam: The surface waters off Vizhinjam attained a maximum temperature of 30.45°C in the month of May. A gradual cooling during the south-west monsoon was observed from June to August by which month the mean temperature of the surface waters was only 24.5°C. The dissolved oxygen of the surface waters was maintained at values higher than 4.7 ml/l throughout the year, except for the month of September when the dissolved oxygen value was reduced to 3.7 ml/l. The south-west monsoon enriched the waters with respect to phosphate which was about 4 /μg at /l in the month of August. In other seasons the phosphate value varied from 1.5 /μg at/l to 2.5/μg/l. Like dissolved oxygen, phosphate value also got reduced in the month of September when it was less than 0.3 /μg at/l. The nitrite value of the waters was 0.43 /μg at/l during hot weather season, during monsoon it was 0.73 /μg at/l and in winter it was about 0.26/μg at/l.

Tuticorin: Observations in the shelf waters off Tuticorin were made on the air temperature, salinity and temperature, dissolved oxygen, hydrogen ion concentration, phosphate and nitrite values. The seasonal variations of surface water temperature closely followed the trend of the atmospheric temperature. Two maxima in May and October and two minima in September and January were noticed. Inorganic phosphate measured was very low (0.03 to 0.09/μg at/l) throughout the year. However, the nitrite values were relatively higher during southwest monsoon (0.24 to 0.38/μg at/l). During winter season the nitrite values were steadily maintained at about 0.25/μg at/l.

Mandapam: Hydrological observations were carried out regularly from Palk Bay and the Gulf of Mannar. The water samples were analysed for their salinity, dissolved oxygen, pH, phosphate, silicate and nitrate values. The surface water salinity was minimum (25.0‰) in January in the case of Palk Bay and the minimum occurred in February (26.3‰) in Gulf of Mannar. In both the waters, high salinity, in the range of 34‰ to 36.3‰, was maintained for a prolonged period of eight months from April till November. Dissolved oxygen varied from 3.7 ml/l to 5.3 ml/l. Even though the nutrients varied in a fluctuating way from month to month, both the waters showed a general trend of rich phosphates and nitrates during the southwest monsoon period.

Madras: The physico-chemical aspects of the shelf and adjacent waters off Madras were studied with regards to the surface water temperature, salinity and dissolved oxygen.

Kakinada: From Kakinada Bay waters regular observations were made on air and surface water temperature, salinity, dissolved oxygen content, phosphates, nitrates, nitrites and silicates. The following deductions are made from their monthly mean values for the period from April 1983 to March 1984.

Dissolved oxygen during southwest monsoon period was about 5.3 ml/l and in the other seasons it is about 6.3 ml/l. The average salinity value during the winter season remained at 19.6‰ while it increased to about 30.2 by monsoon season. The nutrients varied in an irregular way.

Preparation of Atlas of inshore hydrographic conditions and areas of upwelling in relation to fisheries (MBO/ES/3)

G. Subbaraju, R. Padmini

The environmental data stored in magnetic tape have been retrieved and statistical methods were applied in order to derive a link between fish catch and environmental parameters. Further work on the preparation of fishery oceanographic atlas is in progress by consolidating available information on inshore hydrography, upwelling and fisheries.

Phytoplankton and primary productivity of the EEZ (MBO/PP/1.1)

K. Radhakrishna, G.S. Daniel Selvaraj, K.G. Girijavallabhan, C. P. Gopinathan, C.V. Mathew, Rani Mary Jacob, V.S.K. Chennubhotla, G.M. Kulkarni

During the year phytoplankton and primary productivity investigations have been continued along the west coast at Karwar, Calicut and Vizhinjam and along the east coast at Tuticorin, Madras and Waltair. The project was revived at Cochin and newly started at Kakinada. During the last quarter, the project was discontinued at Karwar consequent upon the transfer of the project associate. The centrewise progress of work is detailed hereunder.

Karwar: Temperature, pH, salinity, dissolved oxygen, light penetration, primary productivity (light and dark bottle method), phytoplankton counts and important genera were recorded. 21 samples were analysed during the 8 months of observation. Due to pausity of data seasonal trends are not attempted. Very often net productivity was negative indicating that dark fixation is greater than light fixation. There was apparently, no correlation between productivity and phytoplankton biomass, Diatoms dominated the phytoplankton populations.

Calicut: Two stations of 5 m and 10 m depths were sampled, the first at the surface and near bottom and the second at the surface, mid-depth and near bottom.

Data on temperature, salinity, dissolved oxygen, macronutrients (phosphates, nitrates, nitrites and silicates) light penetration, primary (gross) productivity at different depths and for the columns for the months of April and May 1983 and February and May 1984 were collected.

Vizhinjam: Surface samples from two stations were collected (one sample per month). Monthwise data on temperature, salinity, dissolved oxygen, phosphates, nitrites, nitrates and silicates (October-March only) gross and net productivity were collected. The open sea station was more fertile, with maximum gross productivity in September and net productivity in June. Minimum productivity was in February and March. In the Bay station maximum gross/net production was recorded in June and minimum in May.

In general the period August-November appeared to be rich in phosphate concentration as well as primary production. The premonsoon months of March-May are rich in nitrates. No seasonal trend was discernible in nitrite distribution.

Tuticorin: Fortnightly/monthly samples were collected from the surface and near bottom at two stations (10 m & 20 m depth respectively). Gross productivity values only were presented since dark assimilation was higher than photosynthesis in many cases. Observations were not made in May.

The north east monsoon months of October-December favoured high production. In the months of April, July and March productivity near the bottom was greater than at the surface. Turbidity reduced the euphotic column during the southwest monsoon.

July productivity at the surface was as high as 904 mgC/m^3/day. In October near bottom productivity was higher than at the surface. In December productivity was very low. *Skeletonema costatum* attained bloom conditions in April, *Chaetoceros* was dominant in June, and blooms of *Trichodesmium thiebautii* appeared in the first week of November.

Kakinada: Samples were collected during April-August from Kakinada Bay (depth 6-12 m) and during November-December at a shallow station (depth 2-3 m). Transparency, temperature, salinity, phosphates, nitrites, nitrates, silicates, POM, dissolved oxygen and primary productivity were measured.

Maximum gross productivity was recorded during July-August (840 mgC/m3/day) and maximum net productivity during April (330 mgC/m3/day). During May-June and October-December light bottle values were less than dark bottle values. Secci disc readings ranged from 128-370 mm, POM (mg/l) varied from 64 (October and December) to 458 (June and August).

Waltair: Weekly samples for the analysis of temperature, salinity, dissolved oxygen, phosphates, nitrates, nitrites and silicates were collected at two stations (35 m and 55 m depths) from 6 and 7 depths respectively.

Primary productivity experiments were conducted by the radio carbon method. The ^{14}C and chlorophyll filters could not be processed in time due to repairs to the instruments.

Nutrient data were analysed upto November, 1983. Analysis of subsequent samples (December '83 - March '84) is held up due to repairs to the spectrophotometer. Phosphates were not detectable during April and May. The values fluctuated widely from undetectable level to 71.28 /µg/l at different depths. Nitrate data are very scanty. Nitrites fluctuated from 1.31-27.2 /µg/l at different depths. Silicates varied from 66.1 (surface) to 545.29 (45 m).

Chlorophyll and radio carbon samples were filtered and the membranes are preserved. The analysis is in progress.

Zooplankton in relation to productivity, recruitment and fisheries (MBO/PL/1)

T.S. Naomi, C.V. Mathew, K. Rengarajan, P.A. Thomas, Rani mary Jacob, Pon Sirai-meetan, S. Krishna Pillai, K.G. Girijavallabhan

Work on secondary production was carried out at Madras, Mandapam, Tuticorin, Vizhinjam, Calicut, Mangalore and Karwar besides Cochin.

Eventhough fish eggs were present in numbers ranging from 92 in December to 308 in September in all but February samples, the fish larvae were present only in December. The cladocerans swarmed in September. The copepods always dominated over the other groups.

In the Gulf of Mannar plankton was richer due to the swarming of *Cassio acicula*, in April reaching a value of 30 ml while in Palk Bay the maximum obtained in June was only 3.8 ml. Next to copopods the decapod larvae dominated.

Off Tuticorin the zooplankton volume ranged from 3.9 ml in March to 28.4 ml in June. The copepods varied from 33 to 84% while fish eggs constituted 20%.

Off Vizhinjam the plankton maximum was noticed in August with minimum in April. Next to copepods, the decapod larvae formed the major constituents.

Off Calicut the sampling was carried out only during the period when sea was calm, so an overall annual picture is not available. In Mangalore and Karwar also sampling could be conducted only in April and May.

At Cochin the emphasis was only on distribution, ecology and biology of the euphausiids of the Indian seas in relation to hydrographic parameters. The northward limit of several species of euphausiids have been further extended and status of *Stylocheiron armatum* has been revalidated. The quantitative distribution of all the species occurring in the southeastern Arabian sea has been worked out.

Eggs and larvae of commercially important fishes from the shelf and adjacent waters (EEZ) (MBO/FEL/1.1)

K.C. George, K. Rengarajan, Rani Mary Jacob, K.C. Girijavallabhan, S. Krishna Pillai and Pon Siraimeetan

Fish eggs and larval work has continued intensively at Cochin, Vizhinjam, Madras and Tuticorin. At all Centres regular samplings were undertaken from the inshore waters and the environmental conditions were also monitored. Abundance of eggs and larvae in relation to environmental parameters in the inshore waters was assessed in order to find out the recruitment trend to the major stock of pelagic and demersal fisheries. Studies on fish eggs and larvae from earlier collections taken from *R.V.Rastrelliger* were continued.

Culture of economically important seaweeds (MBO/SW/1.2)

N. Kaliaperumal, Geetha Bharathan

Seaweed culture experiments were conducted in the nearshore waters of Palk Bay near fish farm and in the fish farm feeder canal. *Gracilaria edulis, Acanthophora spicifera, Sargassum ilicifolium, Turbinaria conoides* and *Ulva lactuca* were grown in coir nets.

Attempt was made for the first time to cultivate the algin yielding seaweeds *Cystoseira trinodis* and *Hormophysa triquetra*.

In the laboratory attempts were made for the settlement of *Ulva lactuca* germlings on different substrata like coral stones, tiles, plastic buoys and plastic sheets.

Studies on sporulation from tetrasporic and cystocarpic plants of *Gracilaria arcuata, G.corticata* var. *cylindrica, G.foliifera* and *Gracilariopsis sjoestedtii* in relation to environmental factors such as exposure to air (dessication), salinity, light intensity, photoperiod and temperature have been initiated.

Environmental monitoring in the industrial and adjacent area of the Cochin Backwater system (MBO/EE/1.4)

C.P. Ramamirtham and I. David Raj

Under this project the investigations in the Cochin-Azhikode and Cochin-FACT areas were continued. During early June, in the Cochin-FACT area the surface temperature values were comparatively very high especially in the FACT site where it rose to about 34°C. The onset of monsoon in July has affected the estuarine area drastically and thus in the Cochin-FACT area the surface temperature during early July was only 23.8°C.

The bottom layers of the two estuarine areas were observed to be affected by monsoon upwelling, only from mid August onwards in a noticeable manner. The FACT area also exhibited such trends

during peak monsoon. By October, the monsoon characteristics have disappeared in both the estuarine areas of the Vembanad lake.

The winter conditions during December were not so conspicuous in the Cochin-FACT sector except for the Bolgatty station where an inversion in temperature values occurred during mid December.

Marine Pollution in relation to protection of living resources (MBO/MP/1.1)

P.V. Ramachandran Nair, V. Kunjukrishna Pillai, A. Geethanand Ponniah, S. Muthuswamy and R. Marichamy

An intensive study of the pH of the water samples collected at various stations of the backwater system covering the whole area extending from Aroor to Alleppey and the paddy fields and the inner canals (feeding canals) of Kuttanad area revealed that the phenomenon of mass mortality of fish in the Kuttanad area might have been caused by soil acidity. Most of the pH values recorded were in the range of 3.0-7.0. It was significant to note that during the initial sampling time the pH of the water collected from the paddy fields as well as from the open waters of the southern end of Vembanad lake was very low pH (4.0). In the paddy fields the pH was only 3.8 and remained without much variation for a considerable period. This revealed that the low pH was mainly due to the leaching out of acid waters from the paddy fields and adjacent canals. Also, the effect of pH reduction seemingly influenced the eco-system only up to the middle of the lake and towards the mouth of the estuary the effect appeared to have got neutralized probably due to the regular tidal action.

Few more instances of mass mortality were observed in the lake as well as uncultivated paddy fields subsequently. Except for the immediate mortality to fishes (cat fishes, rays, *E roplus* and mugil), crustaceans (mainly crabs - *Scylla serrata* and *Macrobrachium* sp.) and clams (*Villorita* sp.), the subsequent incidence of mortality were rather limited to the young ones of cat fishes (*Keletius* sp.). During the latter period of survey it was observed that there was limited fishing activity mainly for *Etroplus* and *Macrobrachium*. However, the destruction to the clam beds (*Villorita* sp.) is massive and even after a few months from the first report there was not even a single live clam specimen available in the southern half of the lake beyond Thanneermukkom. The fact that, though during the later field trips the acidity was found reducing slowly, still low pH persisted in the southern area of the lake and paddy fields indicated beyond doubt that the real causative factor for the low pH originated from the soil acidity.

Environmental monitoring of aquaculture system (MBO/MP/1.2)

V. Kunjukrishna Pillai, V. Chandrika, Geetha Bharathan, M. Rajagopalan and K.G. Girijavallabhan

During the period under report monitoring of the environmental conditions of the Muttukadu saline lagoon and the fish and prawn culture ponds of the Mariculture Centre was carried out.

Surface and bottom water samples of three stations in the open water area were investigated apart from a total of 17 ponds. The prevailing high temperature and salinity and the enclosed nature of the water body resulted in an intense bloom of dinophytes. This led to oxygen depletion of the water and then of the mud.

A rising trend in salinity values of surface waters from April to July 1983 took the value up to 47.12 ppt. A decline set in after this, bringing the value down to 15.89 ppt in December 1983 following heavy rains towards the end of November.

Mean levels of dissolved oxygen in surface waters were between 3.0. and 4.0 ml/l during April-July. Values went up above 4.0 ml/l in August 1983 but remained below 3 ml/l until November.

Unlike other factors the trends in dissolved oxygen levels were different for the open area and ponds. While the trend in the open canal area appears to be related to trends in temperature (high oxygen levels associated with low temperature) it is not so for the ponds, where biological conditions are very different.

Fluctuations in gross productivity values were very high. The surface waters showed high gross productivity during April-June 1502-51 mgC/m^3/day being the value for April. A gradual decline from July to September brought the mean value down to 568.87 mgC/m^3/day. The bright period of April-May, which also was the period of dense blooms, showed maximum levels of productivity.

Mean monthly values of chlorophyll were generally high from April to July and registered a sharp, drop in August. This pattern was true of the surface as well as bottom samples of the canal area, where values were 19.76-28.79 mg/m^3. Nutrient levels were in general rather low, with some appreciable increase during the month of June.

In conclusion, it may be observed that the lack of water exchange in the farm, especially in ponds in the B-series, led to conditions of extremely high salinity. The enclosed nature of these ponds was further noted from the differences in seasonal patterns of variation in transparency, chlorophyll *a* and gross production in the open canal area and A-series ponds on the one hand, and the B-series ponds on the other. Construction of sluices in these ponds may alleviate this problem to some extent, and it is recommended that this be done.

Investigations on the pesticide residues and heavy metals in the environment and living resources of the estuarine and inshore water (MBO/MP/1.3)

V. KUNJUKRISHNA PILLAI

Further calibrations were carried out with the standards obtained from the Environmental Protection Agency, U.S.A. A double distillation was carried out to purify the solvent hexane used in the analysis. Further work was held up due to problem with GLC.

Ecology of the mangrove swamps and their associated fauna and flora (MBO/MS/1.1)

M.S. RAJAGOPALAN, G.S. DANIEL SELVARAJ AND D.S. RAO

Regular monthly data on physical and chemical features of the mangrove ecosystem were collected with reference to temperature, transparancy/turbidity, viscosity, salinity, dissolved oxygen, micronutrients (inorganic phosphate, silicate, nitrite and nitrate) and seston in water, particle-size, organic carbon and total organic matter in sediments. Regular data on biological aspects on primary productivity, zooplankton biomass and bottom macrofauna were also collected and their distribution pattern, seasonal variations and inter-relationships studied.

Two extensive surveys were made along the 'mangrove estuaries' adjoining the Kakinada Bay during April and October-November. Analyses were completed for the various ecological aspects during the period and the effects of summer and N.E. monsoon on the distribution of hydro-biological features in the mangrove ecosystem studied. Based on these general surveys, the ecological characteristics of the mangrove biotope of East-Godavari District was formed.

Analyses of sediment samples for particle size, organic carbon and total organic matter indicated that regions of fine sediments (< 0.125 mm) were rich in organic carbon content.

Among penaeid prawns, *P.indicus* seeds were abundant in Chollangi and Coringa estuaries (annual mean of 10 and 6 nos. per 10 scoops) with peak during June-September. *M.dobsoni* seeds were abundant in B.V. Palem and Coringa estuaries with their annual mean being 25 and 16 nos per 10 scoops respectively. The peak month was September.

Among non-penaeid prawns, *Macrobrachium* seeds were common, of which *M.malcomsoni* were dominant, followed by *M.rude* and then *M.rosenbergi*. They were available throughout the year.

Investigations on the biology of marine turtles, cetaceans and the dugong in relation to their conservation and management (MBO/MM/1.1)

E.G. Silas, V. Kunjukrishna Pillai and M. Rajagopalan

During the period under report a total number of 8133 eggs of olive ridley *Lepidochelys olivacea* were collected for conservation from Adyar to Mamallapuram coast in Tamil Nadu. Of the 8133 eggs kept for hatching 5011 eggs hatched out (61%) The studies on growth of olive ridley in captivity at Mariculture farm, Muttukadu was continued.

Observations were made during the mass nesting of the olive ridley during January and February 1984, at Gahirmatha turtle rookery in Orissa. Abnormalities and teratological conditions were seen in turtles both at the mass nesting phase as well as during the post mass nesting phase.

Design and development of a structural work opposite main sluice to minimise sand deposition (FED/MC/E/122)

P. Bensam

A structural work for construction of breakwaters to minimise sand deposition taking place during and after North-East monsoon season was designed. It was in the form of two breakwaters on eigher side of the main sluice. In order to maximise deflection of waves carrying sand, the eastern breakwater was designed to be partly covered by extensions from the western breakwater. Granite and coral stones available in the office premises were transported to the work spot, for construction of the breakwaters.

Ecology and behaviour of reef fishes (FED/Misc/2)

Madan Mohan, C.S. Gopinadha Pillai

Study of reef fishes from different habitats shows both quantitative and qualitative difference at different sites. At any specific site the population is restricted to a maximum of 20 species out of more than 300 species recorded earlier Herbivorous, carnivorous and omnivorous fishes have specific habitat selection at certain reef areas. The lagoon reef fish especially live baits have dwindled either due to over exploitation or due to failure of recruitment.

Attraction of fishes by acoustic methods (FED/Misc/3)

S. Natarajan

Work on the recording of sound produced by eels and lobsters was conducted using a Precision Amplifier. The experiment was aimed at establishing the spectral characteristics of sounds produced by the groups of animals. However, the recording was not successful and suitable type of instrumentation are being procured to take up further study on this aspect.

Culture of Marphysa gravelyi (FED/Misc/5)

K. RANGARAJAN AND M. RAJAGOPALAN

A survey of the backwater at Muttukadu was carried out to map out the occurrence of polychaete *Marphysa* which bas a great demand as a bait. The egg masses were hatched out and the young worms were seeded in a layer of mud to observe their further growth. The project has been subsequently closed.

Introduction of low cost instrument technology in fishery research (FED/IT/1)

S. NATARAJAN

AC/DC automatic switch-over, transportable mini aerator and Flow meter and electronic larvae counter were fabricated and tested.

Design and development of feed dispenser (FED/IT/2)

B.S. RAMACHANDRUDU

The timer controlled electro magnetic feed dispenser was tested with *Isocrysis* larval feed in pearl oyster culture and was found to save time and man-power and lead to better spat settlement.

Development of suitable digestor for coastal villages (FED/BT/2)

V. CHANDRIKA

Estimation of bacteriochlorophyll of the mixed green photosynthetic bacteria was done and chlorophyll *a* was found to be more in January (1073.6 mg/m^3). But the minor pigment in all green bacteria is behl *a* and it is the form of chlorophyll in the photochemical reaction centres of bacterial cells. The high value of chlorophyll *a* may be because the three light-harvesting chlorophylls (bacterial chlorophyll *a*, c & d) which occur among green bacteria resembled chlorophyll *a* rather closely in spectral properties. Sterilised aged sea water and Asparagin crystals formed very good medium for green sulphur bacterium if it is incubated in the presence of subdued sunlight. Intense green colour was found developing after a fortnight's time. Based on these studies it was inferred that the culture belongs to the family Thiordaceae (Chromatiaceae). The mixed culture was tentatively indentified as *Chlorobium liminicola* and *Rhodopseudomonas* spp.

PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

Researches on 15 projects, one each relating to ecophysiology and physiology of penaeid prawns, 3 on reproductive physiology and endocrinology, 6 on nutrition and 4 on pathology of fishes and shellfishes were carried out under the Division's programme during 1983-84. On accomplishing the objectives, five projects were completed during the year and one project (PNP/14) was terminated on the deployment of staff to other priority research needs.

Free Amino acid and protein levels in *Penaeus indicus* as a function of selected environmental factors (PNP/1)

A.G. PONNIAH, V.S. KAKATI, KARUPUSWAMY

The main objective of the project, which was initiated in 1982, was to understand the free amino acid (FAA) and protein variations in *P.indicus* in different salinity media, and the consequent changes in the physiology of the prawn, and to find out whether these parameters could be used as a predictive index of the onset of abnormal 'soft' condition in the prawn. The problem was studied from three aspects, namely, seasonal monitoring of FAA and protein in the prawn obtained from backwaters along with environmental factors, determining the FAA and protein levels in 'soft' and healthy prawns from culture fields and experimental studies on the relation between salinity stress and phenomenon of 'softness' in the prawn.

Seasonal studies in the FAA and protein levels in *P.indicus* during 1982 and 1983 showed that there was no significant correlation between the environmental parameters such as salinity, pH and dissolved oxygen of the backwater and the above biochemical levels.

Laboratory experiments were conducted at salinities 10 ppt, 15 ppt, 20 ppt, 15 ppt and 32 ppt on *P.indicus* collected from a pond where 'softness' was noticed, to test the effect of salinity change on the incidence of 'soft' condition. The results indicated that the salinity did not influence the incidence of 'soft' prawn, but 20 ppt salinity medium was found to be the optimum as indicated by the biochemical parameters and reduced mortality of the experimental animals in the medium.

Studies on the variation of FAA and protein in the 'soft' and healthy prawns collected and analysed from the culture ponds revealed that a high level of protein catabolism is taking place in prawns. How-

ever, this would indicate the effect of stress of external stimuli rather than the cause of 'softness'. The low level of FAA in haemolymph of apparently healthy prawns is a noteworthy factor.

Controlled breeding of grey mullets and *Siganus* spp. (PNP/3)

L. KRISHNAN, M.K. GEORGE AND G. MOHAN RAJ

Breeding experiments on *Mugil cephalus* and *Siganus* spp. in controlled conditions were continued at Narakkal and Mandapam Camp respectively. Mature males of *M.cephalus* (35-45 cms total length) in running condition were collected during April-June, 1983. The milt obtained from these fishes and preserved in sterilized glass vials and stored in crushed ice, was found to be motile and active for three days. However, as no mature females were encountered during the period ,breeding experiments could not be undertaken. Between October 1983 and March 1984 breeders were collected on four occasions and maintained in the laboratory for induced breeding experiments. While the males collected during the period were in mature condition, famales were either immature or in the second stage of maturity.

The experiments conducted at Mandapam Camp were concentrated on *Siganus canaliculatus*, *S.lavus* and *S.vermiculatus*. The specimens of the species encountered during April-October, 1983 were mostly in indeterminate or immature stage. However, from December-January, 1984, mature specimens of *S.canaliculatus* and *S.vermiculatus* were collected and breeding experiments were conducted. The experiments were mainly carried out in 3′ diameter pools with running sea water. HCG was administered to both species as inducing agent. In the case of *S.vermiculatus* although initial increase in the size of ova was observed after the hormonal injection, it failed to progress towards maturity and breeding. In *S.canaliculatus*, however, 2 specimens spawned after HCG administration and fertilization was achieved in one case. One more female of *S.canaliculatus* spawned naturally in the laboratory with viable eggs. The size of the fertilized eggs ranged from 0.59 to 0.63 mm in diameter. The incubation time was 28 hrs. The hatched out larvae measured 1.81 mm. The larvae were reared to four days, feeding on *Chorella* spp.

Correlation between the structure of the pituitary and changes in the gonad of the pearl spot, *Etroplus* (PNP/4)

A.D. DIWAN AND L. KRISHNAN

The research programme aims to study the correlation between the structure of the pituitary gland and seasonal changes in the gonads of the pearl spot, *Etroplus suratensis*. The observation made so far showed that the maturation process of the ovary begins from July. Fully ripe specimens occur from October to December. Their percentage occurrence, however, decreases in January and February only to increase again in March and April, indicating two active periods of gonadial maturation in a year.

The histological studies of the pituitary gland of the fish showed six different cell types. Differential staining indicated the role of gonadotrophs in the maturation process of the ovary. Correlation between the gonadotrophs and the different maturity stages were being studied.

Nutritional requriements of fry and fingerlings of the milkfish, *Chanos chanos*, and mullets (PNP/6)

R. PAUL RAJ, D. C. V. EASTERSON AND D. KANDASAMI

The effect of different dietary levels of lipids on the food intake, growth, survival, food conversion efficiency ratio and body

composition of the fry and fingerlings of milkfish, *Chanos chanos*, was studied by feeding purified diets containing graded levels (0-15%) of lipids. The diet with 6% lipid level showed maximum gain in length, wet weight and dry weight. Data on lowest conversion value as well as on protein efficiency ratio showed relatively better utilisation of ingested food with the diet having 6% lipid.

Proximate composition analysis of the experimental fishes showed that moisture content was maximum in the lipid free diet. An inverse relationship was observed between lipid and moisture content of the fish. There was no significant difference in the protein content of the fish among the treatments, although the fish fed with lipid free diet had relatively lower level of protein. The lipid content of carcass of the experimental fishes increased with increase in lipid levels in the diet. Thus, the results of the experiments showed that a lipid level of 6% is the optimum for food intake, growth and utilisation of food and protein.

Experiments conducted to define protein requirements of mullet. *Liza macrolepis* showed that the optimum protein requirement was 40%. The survival rate of the fry and fingerlings was high at this protein level. Another set of experiments to study the effect of carbohydrate and protein levels showed that the diet containing 40% protein, 41—25% carbohydrate and 5% fat was relatively better in terms of growth and protein deposition.

Nutritional requirements of *Anguilla bicolor bicolor* (PNP/7)

D. KANDASWAMY

Six test diets having protein levels ranging between 25 and 55% were prepared with carageenan and agar (2:3) for conducting experiments to understand the protein requirements of elvers of *A.bicolor bicolor*. Caesin, dextrin and fish and vegetable oil (1:2) were respectively, the protein, carbohydrate and fat sources of the diet. With this, the minerals from SISCO company and salt mixture were also included. The total calorific value of each of the diets was 4000 cal/kg.

The results of the experiments showed that the test diet containing 35% protein gave higher growth rate, protein uptake and survival rate of elvers.

Cataloguing of chemical and biological data on the conventional and non-conventional feed ingredients suitable for cultivable marine organisms (PNP/8)

R. PAUL RAJ, M.S. RAJAGOPALAN, SYED AHAMED ALI AND D. KANDASAMI

Data on minerals, trace metals and vitamin composition of oil cakes such as soybean, cotton seed, peanut, sunflower, rape seed, linseed, sesame and safflower were catalogued. Among oil cakes for which data were collected, sesame had the higher Ca level with 1.99%. This was followed by rape seed cake (0.66%). Cu content was more in linseed (46.2 mg/kg) and soybean (36.3 mg/kg) compared to other oilcakes. The Fe content was maximum (560 mg/kg) in safflower cake followed by rape seed meal (180 mg/kg). Sunflower and sesame oil cakes are rich in Mg while, phosphorus content was maximum in sesame meal (1.29%) and safflower cake (1.1%).

The vitamins profile of oil seed showed that biotin is rich in safflower oil cake (1.56 mg/kg) and sunflower oil cake (1.45 mg/kg) compared to other oil cakes. Choline content was relatively more in cotton seed, soybean, sunflower and sesame oil cakes. Safflower and peanut oil cakes are rich in pantothenic acid.

Nutritional requirement of penaeid prawn larvae and juveniles (PNP/9)

SYED AHAMED ALI AND M. VIJAYAKUMARAN

Studies on the nutritional requirements of larvae of *P.indicus* were continued with different purified formula diets prepared and modified on the basis of results of the feeding experiments.

Diet PD-3 having casein, glucose, sucrose, starch, fish oil, lecithin, linoleic acid, cholesterol, glucosamine, HCl, sodium citrate, sodium succinate and vitamin and mineral mix and fortified with choline, inositol, ascorbic acid, sodium silicate and sodium carbonate was prepared as microparticulate powder (45/u) and experimented. The larvae of *P.indicus* fed with this diet could survive only for 4 days when they reached protozoea III/Mysis I stage. Modifying this diet further following the purified diet 'B' used by Dr. Kanazawa, another diet, PD4, using egg albumen as the protein source was prepared. As the results of the feeding experiments with this diet were not satisfactory, this diet was further modified, and diet PD-5, was formulated reducing the albumen from 55 to 40 % and increasing the lipid and calorific value of the diet. On feeding this diet to the larvae the results were almost similar to the earlier experiments although the pH, aeration system were also managed. Subsequently, three more diets PD-6, PD-7, and PD-8 were formulated using vitamin free casein obtained from Canada as protein source. In one of these diets (PD-6) glutamic acid at 0.1% was also included and in another diet (PD-7) a water phobic silica powder was added. As the feeding experiments with these diets also showed similar result, the diet PD-6 was enriched with lipid and used. With this diet, the larvae survived for seven days and reached Mysis II stage with a survival of 40% Further experiments are in progress.

The results of the laboratory experiments to understand the effect of commercial vitamin and mineral mixture, 'Nuvimin Forte' (Manufactured by M/s. Sarabhai Chemicals) on the growth and food conversion of *P.indicus* showed that there is no beneficial effect in the addition of vitamin and mineral mix to the diet formulated with the natural ingredients. Experiments were also initiated to study the qualitative lipid requirements of *P.indicus.*

Nutritional requirements of spiny lobsters (Panulirus spp) (PNP/10)

M. VIJAYAKUMARAN AND E.V. RADHAKRISHNAN

Five synthetic test diets were prepared with protein ranging from 0 to 60 %. Initially, the water content in all the feeds was kept constant, but later altered by reducing in feeds designated as P0, P1 and P2 and increased in the other two for adjusting the stickiness and stability in water.

Two feeding experiments with normal and eyestalk ablated juveniles of *Panulirus homarus* were conducted. In addition, experiment was also conducted with one group of lobsters fed with green mussel (*Perna viridis*) and another group was starved. Due to frequent power cut resulting in failure of aeration, and consequently the mortality of lobsters, all the experiments were concluded prematurely and no conclusions could be arrived at.

Development of artificial and processed natural diet for rearing of bivalve larvae (PNP/11)

D. KANDASWAMI, P. MUTHIAH, S. DHARMARAJ AND A. CHELLAM

Using casesin, soybean lecithin, yeast extract, minerals and oyster extract, and caregeenan as binding agent, four types of diets having different composition were prepared, freeze dried and made to particle size of 20/u. The diets were fed to the

oyster larvae and it was found that particle size of the diet got enlarged due to absorbance of water and found not suitable. Alternate types of diets were prepared using gelatin as a coating substance and fish oil as additional constituent. The feeding experiments carried out with this diet along with *Isichrysis* on pearl oyster and edible oyster larvae showed relatively better growth rate than in the control.

Sporozoan infestation in commercially important prawns (PNP/13)

D.B. James

Between September, '83 and March '84 when regular samples of prawns from the commercial fishery off Madras were examined, penaeid prawns, *P.semisulcatus* and *P.indicus* infected with sporozoan parasites were encountered to varying degrees. In september, 1983, several affected *P.semisulcatus* were collected. Among infected prawns *P.semisulcatus* was dominant, the percentage of diseased prawns varying between 48% and 86%. Data on size range and sex-wise distribution of infected prawns and the degree of infection classified into severe, moderate and mild were collected and analysed for the final report of the project.

Studies on the pathobiology of 'soft' prawns (PNP/14)

P.V. Rao, P.V.R. Nair, M.S. Muthu, C.P.Ramamirtham, A.D. Diwan, R. Paulraj, N. Neelakanta Pillai, A.G. Ponniah, Syed Ahamed Ali, V.S. Kakati, A. Lakshminarayana, S.K. Pandian and Mary K. Manissery

'Soft' prawns which were flabby and emaciated, with thin cuticle, except the stiff rostrum, often with 'wavy' intestine, were encountered during April-May when the salinity and the temperature of the pond water were high and in July-September when low salinity and temperature prevailed. The softness was seen among the prawns of size 85-100 mm in total length.

As one of the principal reasons for 'softness' in the prawns was believed to be the non-availability of natural food for prawns in the ponds, two field experiments were carried out at Narakkal to study the effect of fertilisation of ponds thereby increasing the productivity of the field and the availability of natural food. 50 kg of urea per ha was applied to fertilise the pond which was stocked with hatchery produced seed of *P.indicus* at stocking rates varying from 40,000 to 50,000 nos/ha. Mud sample was analysed after a few days and it was found that the bottom fauna was composed of harpacticoid copepods, ostracods, pennate diatoms, foraminiferans and nematodes. Eventhough the natural food was available in the pond 'softness' was noticed in the pond in April-May.

Environmental monitoring of the pond ecosystem at Narakkal where the incidence of 'soft' prawns was studied during 1982 and 1983 showed the following pattern.

1. During January-May higher values of salinity and temperature were recorded.
2. pH was between 7 and 8 in June, 1982 and July-April 1983; in the other months it was varying between 8 and 9.
3. There was no seasonal trend in the dissolved oxygen content of the pond water.
4. The highest value of NH3-N was recorded in October 1983 in pond 'C', and nitrite in pond B in May 1982. During the other months, the nitrogenous compounds did not build up to a higher value.
5. In 1982, low values of nitrogenous compounds were recorded in August, September and October, whereas in 1983 it was found from February to December.
6. Generally higher values of phosphates and silicates were observed in the ponds

indicating that they were in no way acting as limiting factors.

7. The Eh of the pond mud ranged from +180 to -375. Generally the values were in the negative side and also higher, indicating a highly reducing environment in the pond bottom.
8. Blooms of *Synechocystis salina* with green flagellate *Tetreselmis* and *Chlorella* were usually seen associated with the phenomenon of 'softness' in prawns in the pond. In normal conditions, diatom such as *Skeletonema, Chaetoceros, Thalassosira, Nitschia* and *Navicula* were found to be dominant.

Studies on free amino acids (FAA) and protein in relation to the phenomenon of 'soft' prawns were undertaken during the period to understand the physiological condition of the soft prawns and to determine whether the FAA and protein levels in various tissues of healthy prawns could be used as indices to predict the onset of softness. The results of the studies on these parameters indicated that the FAA, was higher and the protein content of haemolymph and muscle and percentage of dry matter were significantly lower in soft prawns. These data also indicated that a high level of protein catabolism was taking in soft prawns and thus showing the stressed condition of the prawns. Further, it was found that the moisture and ash content were highest in soft prawns, whereas the lipid level was lowest. The high levels of moisture, and low levels of lipids and protein indicated that these energy nutrients were increasingly catabolised for energy purpose.

To study whether the deficiency of nutrients in the food is responsible for softness in the prawns, 6 purified diets, each deficient in one of the nutrients such as protein, fat, calcium, phosphorous, ascorbic acid and vitamin were formulated and experimented. It was found that the 'soft' prawns fed with all the diets deficient in the above nutrients except protein, fully recovered indicating that the 'soft' conditions in prawns was not due to deficiency of phosphorus, calcium, ascorbic acid and vitamins. The biochemical composition of the soft prawn also showed depletion of body protein and lipid in hepatopancreas. There was slight increase in the mineral content (ash) in the body of the soft prawns as compared to healthy prawns. Soft prawns fed with compounded feeds formulated with squilla, prawn waste, groundnut cake, fish oil, tapioca powder and fortified with extra lipid, copper and antibiotic for 10 days recovered and became normal. Further experiments and observations are progressing.

Studies on the hepatopancreas of penaeids (PNP/15)

D.C.V. EASTERSON AND D. KANDASAMI

Carotein content in hepatopancreas of *P. semisulcatus* collected from the wild and in those reared in the laboratory fed with an artificial diet (caesin 35%, carbohydrate 36.9%, fat 5%, minerals 4% and vitamin 1% with zein as binders) were determined. The carotein content in the prawns from the natural population showed an increasing trend with age. It was relatively less in females. In the laboratory reared prawns (mean weight, 12.8 g) the carotein content was 0.41% and 0.35 % in male and female prawns respectively.

Studies on correlation between steroid hormones and maturation of gonads in Pearl spot, *Etroplus suratensis* (PNP/16)

A.D. DIWAN AND L. KRISHNAN

This short-term study was taken up to understand the correlation between the steroid hormones and maturation of gonads in the Pearl spot, *E.suratensis*. Blood samples and gonads collected regularly were subjected to biochemical analysis to find out cholesterol which is the precursor

of steroid hormones. Before initiation of biochemical estimation, gonadosomatic index and the maturity stage of the fish were assessed. It was observed that alongwith the increase of gonadosomatic index the cholesterol level both in the blood and the gonad also increased. The project was completed in March, 1984 and the final report is being prepared.

Investigation on the diseases of cultured eel (*Anguilla* sp.) (PNP/18)

S. MAHADEVAN AND K. DORAIRAJ

During the period under report, eels in the controlled culture facility were observed for various types of diseases. A number of debilities affecting the stock were recorded by noting the signs and symptoms. The diseases encountered were coloumnaris, gill rot, lesions on the body, fin rot, blindness of the eye, cauliflower disease and tumour on head. Occasional mortality due to the above diseases except tumour disease were noted and improvement of water quality was found effective to check the mortality ratio in the case of white patch disease (lesions) and coloumnaris.

The project was terminated due to release of associates of the project for other duties.

FISHERY ECONOMICS AND EXTENSION DIVISION

The Division had ten research projects during the year covering topics such as socio-economic status of fisherfolk, role of women in fishery allied activities, price spread, and extent of adoption of mariculture practices. The salient results obtained are briefly presented.

Surveys of small-scale fisheries in southern region to study the socio-economics of coastal rural sector (FE & E/1)

R. SATHIADHAS AND K.K.P. PANIKKAR

A socio-economic survey was carried out at Thiruvottiyoorkuppam and Pudumanikuppam fishing villages near Madras. All the 137 fishermen households in Thiruvottiyoorkuppam and 601 households in Pudumanikuppam were covered in the survey. The fishermen families of Thiruvottiyoorkuppam are wholly depending on indigenous fishing whereas the fishermen families of Pudumanikuppam depend on traditional as well as mechanised fishing.

Analysis of data revealed that 54% of the fishermen households at Thiruvottiyoorkuppam and 16% of the households at Pudumanikuppam have ownership on the means of production.

In Thiruvottiyoorkuppam the literary rate is about 60%. Almost 56% of the working population are engaged in active fishing, 32% in fishery related activities and 12% in other activities. The average annual income after deducting operational expenditure of fishermen households depending wholly on active fishing or fishery related activities is found to be Rs. 3500/- while fishermen households where atleast one member is engaged in other occupation is found to be Rs. 5400/-.

In Pudumanikuppam 33% is the literacy rate. About 59% of the working population of this area is engaged in active fishing, 36% in fishery related activities and 5% in other activities. The average annual income after deducting operational expenditure of fishermen households depending wholly on active fishing or fishery related activities is found to be Rs. 5100/- while fishermen households where atleast one member is engaged in other occupation is found to be Rs. 7500/-.

In the next phase, sample families in both the villages will be selected for continuous obervation for a period of one year.

Price spread at selected fish markets (FE&E/3)

K.K.P. PANIKKAR AND R. SATHIADHAS

Price data for all commercially important fishes collected from Cochin Fisheries Harbour and a number of consumer markets have been tabulated and analysed. The components of marketing margins for all commercially important varieties of fish have been estimated. At the Trivandrum Terminal Market in consumer's one rupee the fishermen's share was about 28 ps, wholesaler's profit 18 ps, retailer's profit 30 ps, marketing expenditure 17 ps and middleman's commission 7 ps. Fishermen's share in consumer's rupee for fish marketed at retail centres around Cochin (within 100 km.) worked out to about 30 ps for oil sardine, 45 ps for cat fish, 55 ps for shark and 65 ps for seer fish. The study showed that fishermen's share in consumer price is comparatively higher for costly fishes like seer fish and pomfret and lower for cheaper fishes like oil sardine, cat fish and anchovies.

The study has been extended to East Coast selecting Kasimedu fish landing centre as the producer market and a number of consumer markets within and outside of Madras city. Work on collection of data on the prices of different varieties of fish in each quarter at various points such as landing centre, wholesale market and retail markets has been initiated.

Economics of Mechanised Fishing Units (FE/E/4)

K.K.P. Panikkar, T. Jacob and R. Sathiadhas

Collection of data on costs and earnings from Fisheries Harbour, Cochin, was completed. The data collected from the sample units of purse seiners, trawlers and gill netters have been tabulated.

The study indicated that the pay-back period for purse seiner was 3.4 years, trawler 5.5 years and gill netter 3.4 years. The ratio of net profit to initial investment was 29 per cent for purse seiner, 18 per cent for trawler and 29 per cent for gill netter. The net profit per day of operation worked out to Rs. 1173/- for purse-seiner, Rs. 138/- for trawler and Rs. 182/- for gill netter. Net profit is estimated after deducting operational costs, depreciation and interest for initial investment from the gross returns.

Economic evaluation of paddy-cum-prawn culture (FE & E/5)

R. Sathiadhas, K.K.P. Panikkar, T. Jacob and U.K. Sathyavan

In the traditional paddy-cum-prawn culture in Kerala, which is mostly prevalent in Ernakulam district, paddy cultivation is done in the fields adjoining backwaters during June-September and prawn fishery is carried out during October-April. The data collected from 70 sample holdings covering an area of 164 hactares through a continuous survey in 1981-82, and the follow-up survey in 1983 were critically analysed and a report prepared.

The annual net income from both paddy and prawn culture worked out to Rs. 8180/- per hactare for the farmers practising both paddy and prawn culture and Rs. 5130/- for the leased-out farms. The cost of production per quintal of paddy worked out to Rs. 140/- while the average price realised was about Rs. 190/-. The average yield per ha was about 19 quintals. The cost of production of prawns was Rs. 10/- per kg and the average farm price realised was Rs. 12/- per kg. About 80% of the cost was accounted by lease value of the farm. Prawn catches (per ha) during the season were 620 kg in Vypeen, 410 kg in Parur and 260 kg in Varapuzha. *M.dobsoni* accounted for the bulk of the prawn catches (63%) followed by *P.indicus* (27%), *M.monoceros* (9%) and *P.monodon* (1%). About 100 kg of fishes and crabs per ha were also caught during the season. The total value of the catches worked out to

Rs. 7670/- in Vypeen, Rs. 5180/- in Parur and Rs. 2830/- in Varapuzha. *P.indicus* dominated in value accounting for about 60% followed by *M.dobsoni* (23%),*M.monoceros* (9%), *P.monodon* (4%) and fishes (4%).

The total prawn production from the paddy-cum-prawn fields in Ernakulam district is estimated at 2500 tonnes valued at about Rs. 29 million. The estimated labour days required for paddy cultivation and prawn fishing per year was about 0.94 million.

A study on the role of women in small-scale fisheries in Vypeen, Kerala (FE & E/6)

KRISHNA SRINATH

The main object of the project is to identify areas and to assess the extent of participation by women in pre and post harvest operations in small-scale fisheries and to examine their socio-economic conditions. A descriptive survey was conducted in Vypeen area of Kerala State and relevant data were collected from about 500 fishermen households. The salient features of the study are as follows.

In the small-scale fisheries of Vypeen Island, women play an important role in pre and post harvest operations, the significant participation being in prawn peeling, fish curing drying and marketing. These activities are highly seasonal. The average income per week during the season worked out to Rs. 20 in the case of prawn peeling and Rs. 30 per week in trading of backwater fish. The extent of participation depended on the geographical position of the villages and nearness to infrastructure facilities. Hand braiding of fishing nets is another area of their participation. But it is a highly time-consuming activity and the income derived is around Rs. 10 per week. Women of a certain community engage themselves in fishing in the canals searching with hands and earn about Rs. 50/- per week during the season. About 700 families in Edavanakkad-Munambam region earned their livelihood from clam fishing. While the men go out in canoes to fish whole clam the women and children collect clam shells from near-shore areas with an average earning of Rs. 60/- per week, which is also seasonal. These activities are to a certain extent, governed by caste, though caste structure does not bar the women from taking up any income generating activity. The women had the freedom to spend their earnings. They showed willingness to acquire new skills like aquaculture and handicrafts.

The marine fishing villages are caught in a vicious circle of poverty. The sanitation and health in the villages have been poor. The diet consists of predominantly fish and rice which meets about 75 per cent of the calories and 50 per cent of the protein requirement as per FAO standards. Protective foods like leafy vegetables and fruits seldom enter their kitchens.

Study on motorisation and its impact on socio-economic conditions (FE & E/7)

K. BALAN, K.K.P. PANIKKAR AND T. JACOB

Motorisation of country crafts started along Kerala coast during 1979. It soon gained momentum and by the end of 1983 over 2000 crafts fitted with outboard engines were in operation. The outboard engines are fitted to plank built boats, dug-out canoes and catamarans. They need petrol for starting and thereafter run on kerosene oil.

The project which aims at studying the economics of the operations of crafts fitted with outboard engines, covered the coastal area from Quilon to Munambam of Kerala State. Motorisation has increased the catches for the individual boats as well as the catches for the entire state. During 1983, the contribution of this sector to

the landings was to the tune of 1 lakh tonnes, accounting to almost one fourth of the total landings for Kerala.

Net income of an owner who operates boat seine works out to about Rs. 87/- per day during lean period and Rs. 300/- during peak period. For a gill netter they are respectively Rs. 35/- and Rs. 82/- and in the case of crafts operating hooks and lines Rs. 38/- and Rs. 188/- per day.

Study on income, consumption and employment pattern and the credit facilities available to fishermen (FE & E/9)

D.B.S. SEHARA, R. SATHIADHAS AND J.P. KARBHARI

A survey was undertaken in North-West coast to study the socio-economic status of fishermen. Mainly four aspects of fishermen economy viz. income, consumption, employment and credit facilities available were covered. Complete enumeration of fishermen families was taken in Ekdara, Alibag Koliwada and Mahim Koliwada fishing villages of Maharashtra and Umargam, Bhimpore, Sutrapada Bunder and Mangrol Bunder fishing villages of Gujarat. The results of the analysis of complete enumeration data shows that average family size varied from 6.9 to 8.1 in the villages of Maharashtra and 7.3 to 7.7 in the villages of Gujarat. Percentage of working population varied from 47 % in Sutrapada Bunder to 58% in Bhimpore. Number of persons employed in non-fishery occupations and literacy among respondents were comparatively more in Mahim Koliwada, Umargam and Bhimpore. About 75% respondents in Maharashtra villages and 80% in Gujarat villages reported fishing or fishery allied activities as their main occupation. Standard of living was found higher in Gujarat. Monsoon (June-August) is a lean fishing period at all the centres except Bhimpore where good hilsa landing is observed during monsoon. Among the selected villages, Alibag Koliwada is specialised in seining non-penaeid prawns, forming 60-70 per cent of catch. Trawlnet, dolnet and gillnet are commonly used in both the States and Bombay duck, sciaenids, pomfret, prawns, cat fish and croakers form major catch in North-West coast. Single family ownership of means of production is more in the villages of Gujarat as compared to those of Maharashtra. Annual fishing days ranged from 192 to 216 in the villages of Maharashtra and 205 to 247 in the villages of Gujarat.

In the selected villages of Maharashtra, highest average annual net fishery income over operational cost was found in Alibag Koliwada (Rs. 6119/- per family) and lowest in Mahim Koliwada (Rs. 4572/- per family). In Gujarat fishing villages, the annual net fishery income over operational cost per family varied from Rs. 4,565/- in Bhimpore to Rs. 8184/- in Mangrol Bunder. In Maharashtra, average indebtedness for indebted families ranged from Rs. 2338/- in Mahim Koliwada to Rs. 4057/- in Alibag Koliwada. Similarly, in Gujarat, indebtedness per indebted family was least in Bhimpore (Rs. 544/-) and highest in Mangrol Bunder (Rs. 5479/-. Number of indebted families ranged from 43% to 85% in the fishing villages of Maharashtra and 51% to 80% in the fishing villages of Gujarat. Further, percentages of families availing loan from fishermen cooperative society were found more in the villages of Maharashtra except Mahim Koliwada and those availing loan from private agencies were more in the villages of Gujarat.

Comparative economics of artisanal and mechanised fishing units in West Bengal Coast (FP & E.D/10)

K.K. DATTA AND S.S. DAN

The object of the programme is to conduct a comprehensive study to under-

stand the economic viability of mechanised and non-mechanised fishing units.

During March-April '83 a pilot enquiry was conducted in order to identify the predominent crafts and gears used in West Bengal area and select the landing centres. The criteria used in selecting the centres are as follows (i) number of units operated; (ii) number of fishing days; (iii) category of fishing units operated and (iv) methods of fishing.

On the basis of the above criteria five landing centres were selected, Jaldah and Digha in Midnapore district and Bakkhali, Frazergunj and Jumbuiland in 24 Parganas.

After the pilot enquiry, two sets of questionnaire were prepared for in-depth study regarding day to day cost and earning data as well as yearly investment pattern on crafts and gears.

During July-August (pre-peak season) field work was started. Field enumerators collected day-to-day data from selected landing centres. 36 days observation was made from 30 units in each selected centre. During October-December '83 (peak season) and January-February '84 (lean season) the same 30 units were covered for 36 days each. During the 36 days observations, detailed information has been collected regarding persons engaged in mechanised and non-mechanised fishing, actual fishing hours; number of trips made each day, cost of boats and nets, repairing and maintenance cost, fuel expenditure, wage cost and other expenses. So far as earning is concerned, specieswise daily catch data and their prices in each day at the landing centre were collected. The analysis work is being taken up.

Design and Evaluation of Teaching Aids for Mariculture Extension (FE & E/11)

KRISHNA SRINATH

The object of the project is to develop and evaluate teaching aids to be used in the extension and training programmes of the Institute. Visual aids including photographs, charts, posters and translites on some of the findings of the Institute were prepared. Planned and organised ICAR's participation in the Cochin '84 All India Exhibition, where activities of CMFRI were displayed. Audio-visual presentation on the operational details of prawn culture technology was planned. Photographic work on the activities of Tuticorin Research Centre and Prawn Hatchery Laboratory, Narakkal was planned and executed and slides were prepared.

Mariculture practices - An awareness and attitude study (FE & E/12)

KRISHNA SRINATH

The objective of the project is to study the awareness, source of communication, attitude and constraints involved in the adoption of mariculture practices. An interview schedule incorporating an attitude scale specially developed was pretested. Data were collected from 150 fish farmers, including 30 farmers who received seeds from Marine Prawn Hatchery Laboratory, Narakkal and Government Prawn Hatchery, Azhikode. Analysis of data was initiated.

INTER DIVISIONAL PROJECTS

National programme of tagging commercial Prawns and Fishes (CMFRI/IDP/16)

It may be recalled that the results of last year's tagging experiments conducted at the Harbour Centre in the Cochin backwaters revealed that *P.indicus* would migrate long distances and the experiments provided the first direct evidence that these prawns, nurtured in the backwaters of Cochin, would move into the sea and migrate southward along the west coasi of India, skirt round Kanyakumari and proceed along the south-east coast upto Manappad in the Tinnevelli district.

In view of the great significance of this new finding to the dynamics of the shrimp populations of Cochin, it was felt desirable to confirm this finding by a further tagging experiment in the shrimp grounds of Cochin. Further, as the last year's recoveries of tagged prawns from the Cochin prawn grounds indicated that only a fraction of the prawn population from the Cochin backwaters contributed to the stock that supported a year long shrimp fishery off Cochin, obviously the marine prawn stock of this area is sustained by inputs from other sources as well, either by ingress from else where or by self replenishment or both. It was therefore proposed to investigate whether recruitment into the prawn grounds took place from the northern regions along the Kerala - Karnataka coasts which yielded substantial prawn landings. Thus, tagging operations were undertaken in the prawn trawling grounds off Calicut, so that at least we may know whether there is a southernly migration of prawns from this area.

Calicut

4110 prawns (1443 *P.stylifera*, 2 *P.monodon*, 837 *P.indicus*, 470 *M.affinis*, 1197 *M.dobsoni* and 161 *M.monoceros*) were marked and released off Calicut between 2–3–'83 and 9–3–'83. While 60 of these prawns were recovered within 20 km of Calicut within a period of 2 weeks, one prawn, a male *P.indicus*, was recovered in the Alleppey coast at Arthungal 184 km south of Calicut by a drift net 213 days after its release. During this period it had grown 43 mm attaining a size of 166 mm. Another *P.indicus*, a female, was recovered from Overi in Tinnevelli district 628 km from Calicut, 149 days after release. In liberty it had grown 62 mm attaining a size of 172 mm and was in spawning condition.

100 drift bottles had been released from Calicut while releasing the tagged

prawns. A few of them were recovered from many southern places along the Kerala coast and the coast of Kanyakumari district indicating the coastal current to be in the southward direction.

Cochin

8791 prawns (4640 *P.stylifera*, 788 *P.indicus*, 1 *P.monodon*, 11 *P.semisulcatus*, 2256 *M.dobsoni*, 919 *M.affinis* and 176 *M.monoceros*) were marked and released off Cochin between 26-3-'83 and 25-5-'83. While 1909 of them were recovered from the Cochin prawn trawling grounds 3 were caught in different fishing centres in the Tinnevelli district after 58, 86 and 73 days of liberty. The details of the recoveries from long distances and presented in Table -12.

Tuticorin

As has been stated already, Manappad near Tuticorin seemed to be the end point of the migration of *P.indicus* from west coast. To investigate what happens to these prawns after reaching Manappad, a tagging experiment was conducted off Tuticorin during the season.

2190 prawns (842 *P.semisulcatus*, 584 *P.styilfera*, 382 *P.uncta*, 3 *P.monodon*, 102 *P.indicus*, 4 *P.latisulcatus*, 112 *P.maxilipedo*, 2 *P.hardwick'i*, 3 *M.affinis*, 102 *M.monoceros*, 1 *M.brevicornis*, 30 *M.burkenroadi*, 8 *P.merguiensis*, 3 *M.dobsoni*, and 12 *M.mogiensis*) were marked and released off Tuticorin between 21-10-83 and 30-10-83. 176 of the tagged prawns were recovered from the different shrimp grounds near Tuticorin within two weeks of their release. Most of these prawns were mature ones. It would appear that there are areas off the Tinnevelli coast where these prawns go for spawning. The drift bottles recoveries have indicated a southerly current all along the west coast from where the prawns are carried to the southeast coast of India where they spawn. The recoveries of tagged prawns released from Tuticorin indicated no further migration of these prawns. The question arises as to what happens to the young ones that are spawned here where there is no backwater system of reasonable size which could serve as nursery grounds for them. Could it be that they complete the entire life cycle in the sea itself or are they carried by currents which become northerly at this time, to the regions wherefrom their parents arrived?

These are questions to be investigated in the coming years by a suitable combination of tagging and drift bottle experiments.

Table : 12
Details of tagged prawns recovered from long distances

Tag No.	Released on	Recovered on	Days of liberty	Sex	Intial TL mm	TL at recovery mm	Growth	Place and distance km
Prawns released off Cochin								
E 7805	27—4—1983	23-6-1983	58		95	139	44	Kuttapuli, 2765
E 7636	27—4—1983	21-7-1983	86		92	198	108	Kootapani, 333
E 9047	4—5—1983	16-7-1983	73		90	121 (body)		Koodutali, 345
Prawns released off Calicut								
E 3328	8—3—1983	7-10-1983	213		123	166	43	Arthungal, 184
E 3050	7—3—1983	3- 8-1983	149		120	172	52	Overi, 628

Application of Remote Sensing Technology in Marine Fisheries (CMFRI/IDP/17)

G. SUBBARAJU, P.V.R. NAIR, V.K. PILLAI AND A.G. PONNIAH

Sea truth data collection was carried out for remote sensing work. The particulate organic matter and chlorophyll were the parameters that were measured. The particulate matter during the pre monsoon period was found to vary between 5 to 15 mg. The chlorophyll values per unit area was computed to assess the maximum sustainable yield.

Identification and isolation of suitable planktonic microorganisms as mass culture (CMFRI/IDP/20)

C.P. GOPINATHAN, A. CHELLAM, P. MUTHIAH, S. DHARMARAJ

During the year, the isolation, identification and mass culture programme of the phytoflagellates and other nanoplankters were carried out successfully at the oyster hatchery at Karapad, Tuticorin. The phytoflagellates already isolated were grown in large scale and supplied to the hatchery whenever required. Different strains of *Isochrysis galbana* and other Haptophycean flagellates such as species of *Pavlova*. *Dicrateria* and *Chromulina* were also grown in 20 l glass carbuoys and in 100 l persepex tanks providing artificial light and aeration in the A.C, room attached to the hatchery. Besides. *Chlorella salina* was also grown in 21 l glass carbuoys and given to the adult oysters in connection with the fattening experiment and for induced maturation. *Rotifers* fed with *Chlorella* culture were given to the crab larvae as feed during the initial stages of development.

CENTRE OF ADVANCED STUDIES IN MARICULTURE

Under the M.Sc (Mariculture) programme of the Centre of Advanced Studies in Mariculture, 12 candidates belonging to the second batch, admitted in 1981, completed the course. Ten students of the third batch after completion of the second semester, passed on to the third semester of the course. For the recruitment of the fourth batch a total of 263 applications from the candidates from different maritime states such as Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Orissa were received. 152 candidates appeared for the entrance examination and finally 10 students were selected and admitted to the course which commenced on 1st December 1983.

In the Ph.D Programme, which is of three years duration, 18 scholars were undergoing the course. 4 scholars of the 1st batch (1980-83) completed their research work; one of them submitted the thesis to the University of Cochin. Second batch comprising of 9 scholars, admitted in 1981, entered the third year of the course and were progressing in their respective fields of research allocated to them. 250 applications seeking admission to the Ph.D programme of the academic session 1982-85, were received from the candidates belonging to various states, and 10 candidates were finally selected and admitted to the course.

Three expert consultants worked with the Centre during the year. Prof. H.J. Ceccaldi, Station Marine D'Endoume, France, an expert in crustacean physiology visited the Centre during June-July 1983; Dr. P. Sorgeloos, Artemia Reference Centre, Belgium, an expert on culture of live food organisms during January 1984 and Dr. Samy M. Ray, Modi College, Texas A & M University, USA, a specialist on oyster biology and culture during February-May 1984. During their visits they trained scientists, scholars and faculty members in the respective fields by organising group discussions, seminars and conducting workshops.

Six scientists of the Institute were sponsored during the year for advanced training under the individual fellowship training programme of the centre. The fields of training covered were *Macrobrachium* culture, seaweed culture and genetics, crustacean physiology, mullet breeding and culture, culture of live food organisms, and *Euchemia* culture.

Two National Workshops were organised by the Centre during the period under

report to train the scholars and young scientists in important subject matter areas to facilitate up-dating of quality of research and exchanging the technical knowhow. A workshop on "Invertebrate Endocrinology" was organised in collaboration with the Department of Zoology, Marathwada University, Aurangabad from 18th to 24th October 1983 at Cochin. 20 participants attended the workshop. A two-day workshop on the culture of live food organisms with special reference to *Artemia* culture was held in January 1984 under the leadership of Dr. P. Sorgeloos and 11 persons participated in the workshop.

The laboratory facilities were further strengthened during the year by procuring equipments such as micro bomb calorimeter, freeze dryer and phase contrast microscope besides spectrophotometer, polorimenter, electrophoresis unit, T.L.C. and microtomes.

KRISHI VIGYAN KENDRA, NARAKKAL

Training: During the period under report the Krishi Vigyan Kendra, Narakkal has conducted 29 training courses of 5 days duration on scientific prawn and fish farming for the benefit of the farm men and farm women and trained 214 farm men and 313 farm women. Besides, the Kendra has also organised one day training courses on other subjects such as Agriculture, including vegetable cultivation, animal husbandry with special reference to poultry farming-both layers and broilers, duck farming, livestock management, IRDP loan facilities and how to avail them, environmental sanitation, etc. with the help of specialists from the State government departments. In these training courses which were aimed at creating an awareness among the people of the latest scientific methods to be followed to get maximum income out of their limited holdings. The importance of integrated farming also was given emphasis in these training courses. In all 335 men and women were given opportunities to interact with the specialists in the various subjects. About 46% of the trainees belonged to scheduled caste and scheduled tribe.

Table : 13
Details of training courses conducted by KVK during 1983-84.

Area	Duration	Type of training	No. of courses	No. of trainees	No. of trainee days occupied
Prawn & Fish Farming	5 days	90% Off and 10% On campus	13 16	214 farm men	1070
–do–	5 days	–do–	16	313 farm women	1565
Prawn & Fish Farming integrating livestock and agriculture	10 days	–do–	1	17 farm women	170
Duck farming	1 day	On campus	1	35 farm women	35
Poultry farming broilers	1 day	On campus	1	0 farm women	
Poultry farming - broilers	1 day	On campus	1	60 farm women	60
Poultry farming - layers	1 day	On campus	1	42 farm women	42
Live stock development	1 day	On campus	1	26 farm men	26
Agriculture	1 day	Off campus	1	40 farm women	40
Vegetable cultivation	1 day	On campus	1	35 farm women	35
IRDP scheme: Loan facilities	1 day	On campus	1	43 farm men	43
Environmental sanitation	1 day	On campus	1	37 farm women	37
		Total	38	862	3123

Extension: An article in Malayalam entitled *"Chemmeen krishi puthiya reethi kondu nettam"* prepared by Shri K.A.K. Unnithan of the Kendra was published in *"Karshakarangam"* in 'Malayala Manorama' daily.

A number of film shows were arranged for the benefit of the trainees in the campus as well as the school children and public at various schools and other places. Hundreds of people were exposed to the latest technological developments in mariculture and allied subjects.

Two radio programmes were broadcast over the All India Radio, Trichur Station in their "Farm and Home Programme". One was an interview with progressive prawn farmers in which Shri P. Karunakaran Nair participated. The other was a talk on "Prawn Cultivation in Pokkali fields" by Dr. M.M. Thomas.

Dr. M.M. Thomas, Officer-in-Charge of Krishi Vigyan Kendra attended the Fourth All India Workshop on KVK at Nimpith, West Bengal during 29th to 31st October 1983. Dr. Thomas and Shri P. Karunakaran Nair attended the meeting of the Rural Programme Advisory Committee of All India Radio, Trichur. Dr. Thomas gave a lecture on "Mariculture Extension and Education" to the participants of the Reorientation course for the Kerala State Fisheries Officers at CIFT, Cochin.

The Krishi Vigyan Kendra actively participated in the All India Exhibition organised by the Corporation of Cochin from 17-2-1984 to 30-4-1984.

The implementation of the second phase of the Lab-to-Land Programme of CMFRI was done by Dr. M.M. Thomas as the Team leader and Dr. P.K. Martin Thompson and Shri K.N.R. Kartha as members of the team. During this period in addition to the two crops of prawn and fish, vegetable cultivation on the bund was also done profitably increasing the income of the adopted families.

Bench mark survey of 128 Harijan families was conducted at Valappu village in connection with the Lab-to-Land programme. Besides regular village survey was conducted in six villages of Vypeen Island viz. Elamkunnapuzha, Narakkal, Nayarambalam, Edavanakkad, Kuzhippilly and Pallipuram.

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LIBRARY AND DOCUMENTATION DIVISION

Library

A total of 523 books, 840 periodicals and 120 non-book materials were added to the library at Headquarters during the year. The sectoral libraries at the Regional Centre and Research Centres of the Institute were also strengthened with addition of books and periodicals required for regular use there. The library looked after the sales and distribution of the Institute's publications. The library was operating the off-set printing machine and photocopiers for printing Forms, Bills and Booklets for the Institute.

The inter-library loan-system with the libraries of Universities, Research Institutions etc. in and outside the country was continued.

The following library services were also provided by the library.

1. Current Awareness Service (Monthly)
2. S.D.I. Service (Manual)

Publications

The following publications were issued by the Institute.

1. *Indian Journal of Fisheries*
   Vol.30 No. 1
   Vol.30 No. 2

CMFRI Bulletin

No.34. 'Mariculture potential of Andaman and Nicobar Islands - An indicative Survey'.

No.35. Sea turtle research and conservation.

3. *Marine Fisheries Information Service: Technical and Extension Series.* Numbers 47, 48, 49 and 50.
4. *CMFRI Special Publication*
   Numbers 12, 13 and 14.
5. *Fish Trend.* Vol. 1 (Nos. 2–6)
6. *CMFRI Newsletter:* Nos. 19–22.

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LIST OF SCIENTISTS WHO WENT ABROAD FOR TRAINING/ CONFERENCES ETC. DURING 1983-84.

1. Dr. A.V.S.S. Murty, Scientist-S3	: Participated in the International Union of Geodesy and Geophysics (IUGG) 18th Assembly inter-disciplinary symposium held at Hamburg, W. Germany from 15-27 August, 1983.
2. Dr. K.J. Mathew, Scientist-S2	: Participated in the 3rd Indian Antaractic Expedition from 19-1-83 to 1-4-84 organised by DOD.
3. Shri R. Marichamy, Scientist-S2	: Deputed to Japan for Fellowship training in the field of 'Fish Seed Production' for 3 months from 7-3-84.
4. Dr. N. Kaliaperumal, Scientist-S2	: Deputed for 3 months fellowship training in the field of '*Eucheuma Culture*' from 1-1-84 in Philippines.
5. Dr. L. Krishnan, Scientist-S2	: Deputed abroad to undergo training in the field of 'Mullet Culture' at the Oceanic Institute, Hawaii for 4 months from 15-11-83.
6. Shri N. Neelakanta Pillai, Scientist-S2	: Deputed for 3 months training in the field of '*Macrobrachium Culture and Crustacean Genetics*' at Honolulu from 14th March to 13th June, 83.
7. Dr. R. Paul Raj, Scientist-S2	: Attended Workshop on Asian Finfish Nutrition organised by IDRC at Singapore from 22nd to 26th August, 1983.

8. Dr. V.S. Kakati, Scientist-S1 : Deputed abroad to undergo fellowship training under FAO/UNDP programme in the field of 'Crustacean Physiology' in France for a period of 3 months from September 1983.

9. Mrs. Geetha Bharathan Scientist-S2 : Deputed to Japan for training in the field of "Seaweed Culture and Genetics" at the Fisheries Research Station, Kagoshima, Japan for a period of 6 months from 1-9-83.

ENGAGEMENTS OF THE DIRECTOR AND OTHER STAFF DURING THE YEAR 1983 - 84.

Dr. E.G. Silas, Director attended the following meetings:

Seminar on Tuna Fishery at Bombay, 14-15, April.

Seminar on Natural Resources Management System at Hyderabad, 11 & 12 May.
Sea turtle Specialist Group Meeting at Delhi, 13 May.

The meeting on whales in connection with the forthcoming meeting of the International Whaling Commission at U.K.

Meeting of the Central Co-ordination Committee on National Fisheries Survey at Panaji, 15 June.

The Official Level Meeting in connection with the meeting of Chief Ministers at Hyderabad, 25 June.

Zonal Workshop of Fishery Resources Assessment Division at Madras, 27 June.
National Marine Park Meeting on 11 July at Tuticorin and on 1 and 17 August and 17 September at Madras.

Thirtyfifth Annual Meeting of the International Whaling Commission at Brigton, U.K. 15-23 July.

July Ocean Fisheries Commission Meeting at Madras, 22-24 August.

Inter-Ministerial Meeting on Indian Ocean Alliance for conservation called by the Joint Secretary (UN) at External Affairs Ministry at New Delhi, 22 September.

Meeting of the Commonwealth Pre-COFI, FAO at Rome, 9 October.

Fifteenth Session of the Committee on Fisheries (COFI) FAO at Rome, 10-19 October.

ICAR Directors' Conference at New Delhi, 21-28 October.

Review Meeting of the Centre of Advanced Studies in Mariculture at New Delhi, 22 November.

Twentyseventh Meeting of the Scientific Panel for Fisheries of the ICAR at Delhi, 19 December.

Meeting of the ICAR Fisheries Subgroup for Seventh Plan Strategy at New Delhi, 18-19 January, 1984.

International Conference on Biology of Benthic Marine Organisms and chaired the session on Mariculture at Aurangabad, 24 January.

Meeting of the VII Plan Working Group on Agricultural Research and Education at New Delhi, 20-21 February.

Meeting on Logistic Arrangements of New Fisheries and Oceanographic Research Vessel at New Delhi, 25 February.

The Workshop on Sea Turtle Conservation organised by CMFRI in association with the Marine Biological Association of India, Department of Environment and Madras Crocodile Bank, 27-29 February.

Dr. S.V. Bapat, Joint Director attended the following meetings:

Fisheries Panel Meetings of the ICAR at New Delhi, 16-17 May.

ICAR Zonal Sports Meet at Bangalore, 3-4 October.

ICAR Directors Conference at New Delhi, 21-28 October.

First Meeting of the Inter-Institution Infrastructural Facilities Evaluation Committee at Central Inland Fisheries Research Institute, Barrackpore, 25 November and accompanied the Committee during its visit to Madras and Kakinada Research Centres, 26-31 December.

Dr. S.V. Bapat, Joint Director, **Shri T. Jacob** and **Dr. K. Alagarswami,** Scientist-S3 attended the officers level meeting and the Meeting of the Chief Ministers of Maritime States convened by the Ministry of Agriculture, Government of India at Hyderabad, 25-26 June.

Dr. P.V. Ramachandran Nair, Scientist-S3 and **Shri K. Subbaraju** Scientist -S1 attended the Seminar on Natural Resources Management System at Hyderabad, 11-12, May.

Shri T. Jacob, Scientist-S3 and **Dr. Alagaraja,** Scientist, S2 held discussions with the officials of the Department of Fisheries, Pondicherry at Pondicherry and the Statistical Department, Tamil Nadu at Madras to arrive at combined estimates of marine fish production for 1982-83.

Shri A. Noble, Scientist-S2 attended the National Agricultural Research Project Regional workshop on Brahmavari Subproject held at Fisheries College, Mangalore, 27-30 April.

Dr. M.M. Thomas, Officer-in-Charge, KVK attended Rural Radio Advisory Committee Meeting of All India Radio, Trichur, 25 May.

Shri S. Daniel Selvaraj, Scientist-S1 participated in the Workshop on Mangroves organised by the Institutes for Coastal and Off-shore Research, Visakapatnam at Kakinada, 8-9 June.

Dr. Padmini, R., Scientist-S1 visited Space Application Centre, ISRO, Ahmedabad and had discussion with Prof. O.N. Kalla and his group of the Communication Area on the possible applications of microwave radiometers in the measurement of sea surface temperature from the Exclusive Economic Zone, 24 March - 2 April.

Shri K. Kanakasabhapathi, Senior Library cum-Documentation Assistant participated and presented a paper in All India Seminar on Agricultural Library and Information Services sponsored by the Association of Agricultural Librarians and Documentalists of India and Himachal Pradesh. Krishi Vishva Vidyalaya with the assistance of ICAR at Palampur, 4-7 May.

Dr. A.V.S. Murty, Scientist-S-3 was sponsored by the Indian National Science Academy for the International Union

of Geodesy Geophysics XVIII General Assembly, Interdisciplinary Symposium at Hamburg, West Germany, 15-27 August.

Dr. K. Alagaraja, Scientist S-3 attended the VI Agricultural Statisticians' Conference and presented a paper at the University of Agricultural Sciences, Bangalore, 20-30 July.

Shri P. Karunakaran Nair, Senior Training Assistant at KVK attended one month training programme on diversification of agriculture with special reference to small and marginal farmers at the National Dairy Research Institute, Karnal.

Attended the Rural Programme Advisory Committee of The All India Radio, Trichur, 29 August.

Dr. R. Paul Raj, Scientist-S2 attended the workshop on Asian Finfish Nutrition organised by IRDC at Singapore, 22-26 August.

Shri M.H. Dulkhed, Scientist-S2 attended the meeting on Project on Development, Demonstration and Diffusion of Intensive Prawn Culture Technology Working Group Meeting organised by the Karnataka State Council for Science and Technology at Karwar.

Smt. Krishna Srinath, Scientist-S1 attended the Summer Institute on Extension Research Methodology and Agricultural Development organised by ICAR and the Department of Agricultural Extension, University of Agricultural Science, Bangalore at Hebbal, Bangalore, 28 June-19 July.

Dr. K. Alagarswami, Scientist-S3 attended the International Conference on Biology of Benthic Marine Organisms at Aurangabad, 20-24 January.

Shri K. Nagappan Nayar, Scientist-S3 visited Gujarat and reviewed the work done by the Gujarat Department of Fisheries on Culture of Edible Molluscs at the request of the Commissioner of Fisheries, Gujarat.

Shri M.S. Muthu, Scientist-S3 visited Gujarat and reviewed prawn hatchery project of the department of Fisheries, Govt. of Gujarat at Okha, February 1984.

Dr. P.V. Ramachandran Nair, Scientist-S3 visited Gujarat and reviewed the projects on survey and culture of seaweeds and monitoring of marine pollution of the Department of Fisheries, Govt. of Gujarat at Okha, February 1984.

Dr. T. Appa Rao, Scientist-S2 attended a Zonal Workshop of FRAD held at Bombay RC of CMFRI, Bombay from 15-18 June, 1983.

Dr. H. Mohamad Kasim, Scientist-S1 attended the Catfish Resources assessment meeting held at Madras RC of CMFRI Madras 17-18 August 1983.

Attended the Catfish Resources assessment meeting held at CMFRI, Cochin during the month of December '83.

Shri K.K. Sukumaran, Scientist-S2 attended the meeting of the consultation groups for the bases of Exploratory Fisheries Project held at Mangalore on 2-4-1983.

Dr. K. Radhakrishna, Scientist-S2 attended the first course in Agricultural Research Project Managemeent at NAARM, Hyderabad during 23rd Jan. - 16th Feb. 1984.

Dr. G. Luther, Scientist-S2 and **Shri G. Sudhakara Rao,** Scientist S2 attended the workshop on "Food from the Sea to feed a billion by 2000 AD" organised by Department of Science & Technology

Government of India and Institute for Coastal and Offshore Research (INCOR) at Visakhapatnam during 28th and 29th January 1984.

Dr. K. Radhakrishna, Scientist-S3 and **Shri S. Reuben,** Scientist-S1 attended the Seminar on 'Sub-Sea Technology and Commercial Development" held during 23-25 February 1984 at Naval Science and Technological Laboratory (NSTL), Visakhapatnam.

Shri K.A. Narasimham Scientist-S2 attended FRAD Zonal Workshop at Waltair Research Centre of CMFRI during 2-7-83 to 6-7-83.

Shri R. Sarvesan, Scientist-S2 participated and completed the Orientation course in Agricultural Research Management conducted by NAARM at Hyderabad for 30 days from 13 June to 11 July 1983.

Shri M. Rajagopalan, Scientist-S2 attended the workshop on "Sea Turtle" Conservation organised by CMFRI, Cochin from 27th to 29th February 1984.

Shri T.S. Velayudhan, Scientist-S1 participated in the Workshop on Invertebrate Endocrinology from November 18-23, 1983 at CMFRI, Cochin.

Shri S. Mahadevan, Scientist-S3 and Survey Staff attended the FRAD Workshop at Madras from 27-30 June 1983.

Shri S. Mahadevan, Scientist-S3 and **K. Dorairaj** Scientist-S2 attended Workshop on "Approaches to finfish and shellfish pathology investigations" held at Cochin.

Radio Programmes:

Shri T.M. Yohannan, Scientist-S1, gave a talk on whales over All India Radio Calicut.

Smt. V. Chandrika, Scientist-S1, participated in the discussions on Feasibility of bio-gas plants in Kerala in the 'Farm and Home' programme of All India Radio, Trichur, 5 May.

Shri J.P. Karbhari, Field Officer (T7), gave a talk on 'Fisheries in India' in English from All India Radio, Bombay on 5-9-1983 in the Science Magazine Programme and another talk on 'NILI KRANTI' (Blue Revolution) in Marathi from All India Radio, Bombay on 20-12-83 in the Industrial Workers Programme (Kamgar Sabha).

DISTINGUISHED VISITORS TO THE INSTITUTE DURING THE YEAR 1983-84

Headquarters, Cochin and Marine Prawn Hatchery, Narakkal.

Mr. Alhaji D.D. Apanpa, Mrs. Titi Agbalajobi, Mr. Tola Ojo, Mrs. Eunice Opuiah (Lagos State), Nigeria.

Mr. O.A. Ayimla, IAGOS, Nigeria.

Mr. Preben Haub Ard, and Mr. Al Mediratta, FAO HQ Rome.

Mr. Farroq Nooruddin Qasim, Director of Institute of Fish Wealth, Ministry of Fish Wealth, Aden.

Mr. Hubert J. Ceccaldi, Station Marine d'Endoume, Marseille, France.

Prof. Dang Ngoc Thanh, Dr Le Trong Phan, Vietnam.

Mr. G.N. Mitra, Fishery Adviser, Orissa.

Dr. Y.R. Tripathi, Retd. Director of Fisheries, Lucknow.

Mr. A.N. Ghosh, Project Coordinator Brackishwater, Fish culture, CIFRI.

Mr. P. Lavare, H.N. Piwquet an F. Wignard, Ministry of Agriculture, France.

Dr. R.M. Acharya, Deputy Director General (Animal Sciences), ICAR, New Delhi.

Dr. R. Vagarcenkar, CSWRI, New Delhi.

Dr. I.S. Yadav, IIHR, New Delhi.

Dr. S.D. Rai, NDRI, Bangalore.

Dr. T.A. Mammen, Fisheries Adviser, Govt. of Kerala, Trivandrum.

Dr. O.F. Abediyi, Asst. Chief Fisheries Officer and Project Co-ordinator, FAO/ UNDP.

Dr. Maharaj Singh, Project Director, ICAR, New Delhi.

Mr. T.V.R. Pillay, FAO, Rome.

Mr. E.B. Unni, Aspinwal, Cochin.

Mrs. Sarojini Pillay, FAO, Rome.

Mr. G. Rangaswami, Chief Executive, Vorion chemicals, Madras.

Dr. P. Wallis H. Clark, Director, Aquaculture Programme, University of California, U.S.A.

Mrs. Gerals S. Bakus, Associated Professor of Biology, University of Southern California, University Park, Los Angels, California.

Dr. K. Ranga Rao, Professor of Biology, The University of West Florida, Pensacola, Florida 32514-0102, U.S.A.

Dr. D. Desaiah, Ass. Professor of Neurology and Pharmacology and Toxicology, The University of Mississippi Medical Centre, 2500 North State Street, Jackon, Mississippi-39216, USA.

Dr. Hoshi Emora, Qatar.

Dr. P. Sorgeloos, Artemia Reference Centre, Belgium.

Mrs. F.S. Adesunloye, Department of Fisheries, Nigeria.

Regional Centre, Mandapam Camp

Dr. B.K. Tikadar, Director, Zoological Survey of India, Calcutta.

Mr. Samar Singh, Joint Secretary, Department of Environment, Ministry of Agriculture, Government of India, New Delhi.

Dr. A.L.S. Munro, Expert Consultant, DAFS Marine Laboratory, Aberdeen, U.K.

Mr. J. Datta, Additional Secretary, Ministry of Finance, Government of India, New Delhi.

Vice Admiral P.K. Roy, Eastern Command, Indian Navy.

Mr. D. Narayanaswamy, IPS, D.I.G. of Police, Railways, Trichy.

Mr. P. Lavarde and Party (3 members) Ministry of Agriculture, France.

Mr. B.G. Deshmukh, Labour Secretary, New Delhi.

Research Centre, Veraval

Mr. B. Verma, Scientist-S4, R.C. of C.S.W. O.R.T.I., Kota-Rajasthan.

Mr. S.N. Prasad, Scientist-S1, R.C. of C.S.W.C.R.T.I., Kota-Rajasthan.

Research Centre, Bombay

Mr. J.L.R. Putty, Education Officer, Mahatma Gandhi Institute, Mauritius.

Research Centre, Mangalore

Mr. D.M. Amiruddin, Tilery Road, Bolar west, Mangalore.

Mr. Ratnakar Padubidri Mahamayee Indrali, Udupi-576 101.

Mr. C. Ramakrishnan, Deputy Director, MPEDA, Cochin.

Mr. K. Ganapathy Bhat, Asst. Director of Fisheries, Karwar.

Mr. V.K. Shetty, Asst. Director of Fisheries, (C & T), Mangalore.

Mr. K. Premachandran, Asst. Director, MPEDA, Cochin.

Mr. V.I. George, MPEDA, SRO, Mangalore-1.

Mr. A.K. Keshavan Nair, Scientist-S2, CIFT, Cochin.

Mr. A.M. Yellappa Reddy, Conservator of Forests, Kodagu, Madikere.

Mr. V. Nagi Reddi, IFS (P), C/o DFO, Mangalore.

Mr. M.H. Swaminath, Deputy Conservator of Forests, Mangalore Division, Mangalore.

Dr. M. Ramaseshaiah, Department of Marine Living Resources, Andhra University, Waltair.

Dr. R. Sukumaran, Professor of Zoology, Viv Kananda College, Tiruvedakam West, Madurai Dt., Tamil Nadu.

Dr. M. Shemshul Hameed & Dr.C. Hridayanath, Dept. of Industrial Fisheries, University of Cochin, Cochin-16.

Mr. ULF Wiskstrom, FAO Consultant, Suottsfall,S 57800, Aneay, Sweden.

Research Centre, Karwar

Mr. M.Z. Khan, Lecturer, Zoology Departmen, University of Poona, Pune with students.

Dr. R.B. Pawar, Head, Department of Botany, K.V. College, Wai with students.

Prof. M.P. Tonsekar, Head, Dept. of Zoology, Smt. Parvatibai Chowgule College, Margao, Goa with students.

Dr. R.N. Murali, Zoology Department, Sri Sharanabasaveshwar College of Science, Gulburga with students.

Prof. M.S. Mane, D.B.J. College, Chiplun Ratnagiri Dist. with students.

Prof. P.V. Sohani, Dept. of Zoology, Willingdon College, Sangli with students.

Prof. M.M. Momin, Dept. of Zoology, Fergusson College, Pune with students.

Prof. Jacob Thomas, S.D. College, Alleppey, Kerala with students.

Research Centre, Calicut

Mr. Wang Wen-chung, Sangam Bhavans, Thomas street, Colaba, Bombay.

Mr. A. Sankaran, Mayor of Calicut Corporation, Calicut.

Mr. P.R.S. Tampi, Adviser to the Govt. of Kerala, Trivandrum.

Mr. K.T. Mohammed, Former Chairman of Film Development Corporation, Kerala State.

Mr. T.K.A. Nair, IAS, Chairman of MPEDA

Research Centre, Vizhinjam

Prof. Ruth D. Turner, Prof. of Biology, Harvard University, USA.

Prof. Hubert J. Ceccaldi, Station Marine d'Endoume, Marseille, France.

Mr. Mitsuo Yesebi & Mr. T. Sakurai, Indo-Pacific Tuna Programme, Colombo Srilanka.

Mr. Jean-Pierre Flassch, Centre Oceanologique de Bretagne, Brest.

Research Centre, Tuticorin

Mr. R.G. Dandekar, Dy. General Manager, National Bank for Agriculture and Rural Development, Bombay-18.

Mr. V. Chidambaram, Chief Manager, M/s. SPIC, Tuticorin.

Mr. R. Ganesan, Commissioner of Income Tax, Madurai.

Mr. Gavin Young, 'The Observer' London, U.K.

Dr. M.G. Gani, President, Indian Medical Association, New Delhi.

Mr. Mitsuo Yesaki, Indo-Pacific Tuna Programme, P.O. Box. 2004, Colombo Sri Lanka.

Dr. P. Lavarde, Dr. J.A. Piloquet, Dr. F. Grignard, Ministry of Agriculture, 75732 Paris oedex 15, France.

Mr. B. Sivaraman, Chairman, National Marine Park Committee, Delhi.

Dr. C.A. Reddy, Dept. of Microbiology, Michigan State University, Michigan, USA.

Mr. K.G. Kamath, Assistant General Manager, Canara Bank, Madras-600-006.

Dr. A. Mathew & Party, C.M.O., VSSC, Trivandrum, Kerala.

Mr. R. Chandramouli, Dy. Accountant General, Madras-18.

Dr. J.P. Flassch, CNEXO/COB B 8337, 29273 Brest, France.

Mr. G. Rangaswami, Chief Executive, Vorion Chemicals & Distilleries, Madras-18.

Mr. P. Unnikrishnan Nair, Joint Director of Fisheries (Inland), Trivandrum.

Mr. S.K. Sanyal & Dr. Shrivastava, RLC (C) Ministry of Labour, New Delhi, Ravikumar, Ministry of Shipping, New Delhi.

Mr. K.M. Gosh, Controller of Explosives, Sivakasi.

Dr. B.T. Antony Raja, FAO's Bay of Bengal Programme, Madras.

Dr. R. Natarajan, Director & Professor, CAS in Marine Biology, Annamalai University, Parangipettai.

Mr. P.V. Subba Rao, Professor, Central Institute of Fisheries Education, Bombay.

Mr. Seerkhazhi S. Govindarajan, 'Isai Illam', Madras-600 028.

Mr. S. Krishnamurthy, Director, Southern Petro Chemicals & Industries Ltd., Tuticorin.

Mr. R.P. Pillai, Asst. Commissioner of Income Tax, Madras.

Mr. M.V. Kannan, Superintending Engineer (Elec.), Madras Central Elec. Division, CPWD, Madras.

Dr. (Mrs.) Sabto Rao, Minister of Health, Maharashtra.

Mr. K.G. Dave & Mr. K.A. Alex with 10 progressive fishermen of Gujarat State & 6 College parties from Kerala/Tamil Nadu/ Karnataka States.

Research Centre, Madras

Mr. O.A. Ayinla, Nigerian Institute for Oceanography and Marine Research, LAGOS, Nigeria.

Mr. G.N. Mitra, Fishery Adviser, Govt. of India, Cuttack.

Mr. Y.R. Tripati, Retd. Director of Fisheries, U.P., Lucknow.

Mr. P. Lavarde, Piloqutt, J.M., Minister of Agriculture, Paris, France.

Hon'ble R. Birendra Singh, Minister for Agriculture, New Delhi.

Mr. K.C. Acharya, Additional Secretary to Govt. of India, New Delhi.

Mr. S.P. Jakhanwal, Joint Secretary to Govt. of India, Ministry of Agriculture,

Dr. Samuel H. Gruber. Professor of Marine Science, School of Marine & Atmospheric Science, Florida, U.S.A.

Mr. M. Karim Habibur Rahman, FAO, Madras.

Mr. Khondaker, FAO, Bangaladesh.

Mr. Golam Kelenia, Senior Scientific Officer, FAO, Bangaladesh.

Mr. G. Rangaswami, Vorion chemicals & Distilleries, Madras.

Research Centre, Kakinada

Mr. S. Subramanya Sarma, Deputy Director of Industries, Rajahmundry.

CMFRI STAFF SERVING IN DIFFERENT COMMITTEES CONSTITUTED BY OTHER AGENCIES

Dr. E.G. Silas, Director, served as:

1. Member on the joint ICAR-ICSSR Scientific Panel for Social Sciences and Agricultural Extension.
2. Member, Programme Priorities and Cruise Committee for the National Institute of Oceanography, Goa.
3. Member, Research Advisory Committee of the Kerala Agricultural University, Trichur.
4. Member, Central Advisory Committee on Exploratory Survey of Marine Fisheries.
5. Member, Tamil Nadu State Fisheries Research Council.
6. Member, Regional Committee No. 8 (Constituted by the Governing Body, ICAR.)
7. Member, Scientific Panel for Fisheries Research, ICAR.
8. Member, Kerala State Fishery Advisory Board.
9. Member, High Level Aquarium Committee-Construction of Marine Aquarium at Cochin.
10. Member, in the committee on Fisheries and other Aquatic Resources of the State Committee on Science and Technology, Kerala.
11. Member, Central Government Employees Co-ordination Committee Cochin.
12. Member, Faculty of Marine Sciences, University of Cochin.
13. Member, Technical Committee of the Marine Products Development Authority, Cochin.
14. Member, Editorial Committee for 'Indian Seafoods' of the Marine Products Dvelopment Authority.
15. Member, Sub-Committee of the Indian Board of Wildlife.
16. Member, Management Committee of Central Agricultural Research Institute, Andaman & Nicobar Group of Islands, Port Blair.
17. Member-Director of the Board of Directors of the Andhra Pradesh Fisheries Corporation Limited, Kakinada.
18. Member, Standing Scientific Evaluation and Implementation Committee for the Zoological Survey of India.

19. Member, Constitution of the Consultative Group of CIFNET.

20. Member, Technical Advisory Committee on New and Renewable Energy Source, Department of Science & Technology.

21. Co-opted Member, Task Force on Marine Products, constituted by the Ministry of Commerce, Government of India.

22. Convener, Expert panel for Living Resources Programme of the Indian Ocean Region of the standing committee of the Ocean Science Technology Agency (OSTA) of the Department of Science and Technology, Government of India.

23. Member, sub-group on coastal area planning of the task force to prepare the eco-development plan for Goa, set up by the Planning Commission.

24. Member, National Committee for Scientific Committee on Oceanic Research (SCOR) for 1981-84 under the Chairmanship of Dr. S.Z. Qasim, Department of Environment Government of India, by Indian National Science Academy, New Delhi.

25. Member, nominated by ICAR, in the Management Committee section of Krishi Vigyan Kendra, Mitra Niketan, Vellanadu, Trivandrum for a period of 3 years from November 1981.

26. Member, Committee constituted by Government of Kerala to study the need for conservation of marine living resources during certain seasons and allied matters.

27. Vice President of the Interim Executive Council of the Federation of Indian Society of Agricultural Sciences and Technology of the IARI, New Delhi.

28. Member, Research cum Development Forum on Fisheries in the ICAR.

29. Member - Reconstituted Advisory Committee of Employment Information and Guidance Bureau of the Kerala Agricultural University for 3 years from 5-3-1983.

30. Member, Editorial Board of the Indian Journal of Marine Sciences for 3 years term. January 1983 - December 1985.

Shri K.V. Narayana Rao, Scientist-S3 served as:

1. Member in Consultative Group for the CIFNET.

2. Member in Consultative Group for the EFP base at Cochin.

Shri K.H. Mohamed, Scientist - S3 served as:

1. Member in Executive Council of Marine Biological Association of India.

2. Member Secretary in Management Committee, KVK.

Dr. S. Ramamurthy, Scientist - S3 served as:

1. Member Secretary in State Level Committee for Co-ordination of work on Marine Fisheries, Maharashtra.

2. Member in Consultative Group for the EFP, Bombay.

Dr. P.V.R. Nair, Scientist-S3 served as:

1. Member in Panel for Marine Disposal of Effluents CDC 26:3:1 of the Water and Effluents Sub-committee of the I.S.I.

Dr. P. Vedavyasa Rao, Scientist-S3, served as:

1. Member in Executive Council of Marine Biological Association of India.

2. Member in Board of Studies in Mariculture, University of Cochin.

Shri K. Nagappan Nayar, Scientist-S3 served as:

1. Member in State Level Committee for Co-ordination of work on Marine Fisheries in the State and Central sectors.

2. Member in Sub-committee of the Central Advisory Committee on Exploratory Survey of Marine Fisheries.

Dr. B. Krishnamoorthy, Scientist-S3 served as:

1. Central Advisory Sub-Member Committee of Exploratory Survey of Marine Fisheries of the Madras Base of EFP.

2. State Level Committee Member for Co-ordination of work on Marine Fisheries in the State & Central Sectors.

Dr. K.C. George, Scientist-S2 served as:

1. Member in Scientific Committee on Ocean Research and Advisory Committee of Experts on Marine Resources Research of UNESCO/FAO-ACOR/ ACMRR Working Group 67.

Shri M.P. Chandrasekharan, Assistant Accounts Officer served as:

1. Member in Management Committee S.B.I., Coimbatore.

OFFICIAL COMMITTEES CONSTITUTED AT CMFRI BY THE DIRECTOR

Selection Committee for Foreign Assignment/ Deputation Training etc.

Dr. S.V. Bapat, Joint Director	:	Chairman
Dr. P.V. Ramachandran Nair Scientist-S3	:	Member
Dr. K. Alagarswami, Scientist-S3	:	–do–
Shri K.Venkatanarayana Rao Scientist-S3		–do–
Dr. M.J. George, Scientist-S3	:	–do–
Shri G. Venkataranam, Scientist-S3	:	–do–

Building Committee

Dr. S.V. Bapat, Joint Director	:	Chairman
Shri K. Venkatanarayana Rao, Scientist-S3	:	Member
Dr. P.V.Ramachandran Nair, Scientist-S3	:	–do–
Shri K.H. Mohamed, Scientist-S3	:	–do–
Senior Administrative Officer/ Administrative Officer	:	–do–

Transfer Committee

Dr. S.V. Bapat, Joint Director	:	Chairman
Dr.P.V.Ramachandran Nair, Scientist-S3	:	Member
Shri K.H. Mohamed, Scientist-S3	:	–do–
Shri K.Venkatanarayana Rao, Scientist-S3	:	–do–
Shri T. Jacob, Scientist-S3	:	–do–
Dr. K. Alagarswami, Scientist-S3	:	–do–
Shri G. Venkataraman, Scientist-S3	:	–do–
Senior Administrative Officer	:	–do–

Publication Committee

Dr. M.J. George, Scientist-S3	:	Chairman
Dr. K. Alagarswami, Scientist-S3	:	Member
Shri T. Jacob, Scientist-S3	:	–do–
Shri K.N.Krishna Kartha, Scientist-S2	:	Member Secretary

Official Language Implementation Committee

Dr. S.V. Bapat, Joint Director	:	Chairman
Shri G. Venkataraman, Scientist-S3	:	Member
Shri V. Balan, Scientist S2	:	–do–
Shri V.K. Sridhar, Administrative Officer	:	–do–
Shri M.P.Chandrasekharan, Asst. Accounts Officer	:	–do–
Shri K. Kanakasabapathy, Sr. Library-Cum-Documentation Assistant (T4)	:	–do–
Shri M.P. Lakshmanan, Superintendent	:	–do–
Shri A.K. Balakrishnan Pillai, Superintendent	:	–do–
Miss. A. Rajeswari Menon, Hindi Translator (T-4)	:	–do–
Dr. M. Vasudev Pai, Scientist-S2	:	Member Secretary

Library Committee

Shri T. Jacob, Scientist S-3	:	Chairman
Dr. M.J. George, Scientist-S3	:	Member
Dr. A.V.S. Murty, Scientist-S3	:	–do–
Dr. Paul Raj, Scientist-S2	:	–do–
Shri K.N.Krishna Kartha, Scientist-S2	:	Member Secretary

High Power Committee for assessment of field experiments

Dr. S.V. Bapat, Joint Director	:	Member
Shri T. Jacob, Scientist-S3		–do–
Dr. M.J. George, Scientist-S3	:	–do–

Stores Committee

Dr. P. Vedavyasa Rao,	:	Chairman
Dr. P. Vijayaraghavan, Scientist-S2	:	Member
Shri M.S. Rajagopalan, Scientist-S2	:	–do–
Dr. A.D. Diwan, Scientist-S2	:	–do–
Shri G. Subbaraju, Scientist-S2	:	–do–
Shri M.P.Chandrasekharan, Assistant Accounts Officer	:	–do–
Administrative Officer/ Sr. Administrative Officer	:	–do–

Benevolent Fund Committee

Director	:	Chairman
Dr. M. Vasudev Pai, Scientist-S2	:	Member
Shri V.N.Bande, Scientist-S2	:	–do–
Assistant Accounts Officer	:	–do–
Shri S.P.L. Sethu, Superintendent	:	–do–
Shri M.P. Lakshmanan, Superintendent	:	–do–
Administrative Officer	:	Member Secretary

Lab-to-Land Inter-Disciplinary Committee

Dr. K. Alagarswami, Scientist-S3	:	Chairman
Dr. P.V.Ramachangran Nair, Scientist-S3	:	Member
Shri K. Nagappan Nair, Scientist-S3	:	–do–
Dr. P.S. Kuriakose, Scientist-S2	:	–do–

Ship Stores Committee

Dr. S.V. Bapat, Joint Director	:	Chairman
Dr. K.C. George, Scientist-S2	:	Member
Dr. P.V.Ramachandran Nair, Scientist-S3	:	–do–
Shri V.N.Bande, Scientist-S2	:	–do–
Shri S. Natarajan, Field Officer (T6)	:	–do–
Administrative Officer	:	–do–
Assistant Accounts Officer	:	–do–

Committee for drawing norms and guidelines for development of Fish farms

Shri P.R.S. Tampi, Scientist-S3	:	Chairman
Shri K.H. Mohamed, Scientist-S3	:	Member
Dr. B. Krishnamoorthi, Scientist-S3	:	–do–
Shri K. Nagappan Nair, Scientist-S3	:	–do–

Fish/Farm Products Pricing Committee

Dr. P.V.Ramachandran Nair, Scientist-S3	:	Chairman
Dr. K.C.George, Scientist-S2	:	Member
Shri R. Reghu, Technical Assistant (T.II.3)	:	–do–
Shri P.K. Velayudhan (Mate)	:	–do–
Shri M.P. Lakshmanan, Superintendent	:	–do–
Shri P.A. Vasudevan (S.S.Gr.IV) (Lab. Attendant)	:	–do–

MANAGEMENT COMMITTEE OF CMFRI

1. Dr. E.G. Silas, Director, CMFRI, Cochin. : Chairman
2. Dr. P.S.B.R. James, Assistant Director General (F) I.C.A.R. : Member
3. Dr.P.V.Ramachandran Nair: Member Scientist-S3, CMFRI, Cochin.
4. Dr. M.J. George, Scientist-S3, CMFRI, Cochin. : Member
5. Dr. M. Vasudev Pai, Scientist-S2, CMFRI, Cochin. : Member
6. Shri P.T.Meenakshisundaram Member Scientist-S2, Madras Research Centre of CMFRI Madras.
7. Administrative Officer, CMFRI, Cochin. : Member Secretary

INSTITUTE JOINT COUNCIL OF CMFRI

Official Side

1. Dr. E.G. Silas, Director, CMFRI, Cochin. : Chairman
2. Dr. S.V.Bapat, Jt. Director, CMFRI, Cochin. : Member
3. Shri S. Mahadevan, Scientist-S3, Mandapam Regional Centre of CMFRI, Mandapam Camp. : Member
4. Shri M. Kumaran, Scientist-S2, Calicut Research Centre of CMFRI, Calicut.
5. Shri M.P. Chandrasekaran, Assistant Accounts Officer, CMFRI, Cochin.
6. Senior Administrative Officer/ Administrative Officer, CMFRI, Cochin. : Secretary (Official side)

Staff Side

7. Shri K.K. Balasubramanian, Technical Asst. (T.113), CMFRI, Cochin. : Member
8. Shri Joseph Andrews, Technical Asst. (T-I-3), CMFRI, Cochin. : –do–
9. Shri M. Abdul Nizar, Field Asst. (T-1) CMFRI, Cochin. : –do
10. Shri K.C. Yohanan, (T-4), CMFRI, Cochin. : –do–
11. Shri T.N. Padmanabha Kurup, Junior Clerk, CMFRI, Cochin. : Secretary (Staff side)
12. Shri M. Ganapathy, Senior Clerk, CMFRI, Cochin. : Member
13. Shri C.M. Rajappan, S.S. Gr. III (L.A.) Mandapam Regional Centre of CMFRI, Mandapam Camp. : –do–
14. Shri S.M. Hussian, S.S. Gr.III (L.A.) CMFRI, Cochin. : –do–
15. Shri P.A. Vasu, S.S.Gr.III (Fieldman), CMFRI, Cochin. : –do–

GRIEVANCE CELL OF CMFRI

1. Dr. M.J. George, Scientist-S3 CMFRI, Cochin. : Chairman
2. Senior Administrative Officer/ Administrative Officer, CMFRI, Cochin. : Member
3. Shri M.P. Chandrasekaran, Asst. Accounts Officer, CMFRI, Cochin. : –do–
4. Shri M. Ganapathy, Senior Clerk, CMFRI, Cochin. : –do–
5. Shri Joseph Andrews, Technical Asst. (T-I-3), CMFRI, Cochin. : –do–
6. Shri C.M. Rajappan, S.S.Gr.III (L.A), Mandapam Regional Centre of CMFRI, Mandapam Camp. : –do–
7. Shri A.K.Balakrishna Pillai, Superintendent, CMFRI, Cochin. : Non-Member - Secretary.

STAFF POSITION AS ON 31-3-1984

(Not a gradation list)

Director : **Dr. E.G.Silas**
Joint Director : **Dr. S.V. Bapat**

Scientist S-3 (Rs. 1800-2250)

Dr. P.V. Ramachandran Nair
Dr. K. Alagarswami
Shri K. Nagappan Nayar
Dr. P. Vedavyasa Rao

Scientist-S3 (Rs. 1500-2000)

Dr. A.V.S Suryanarayana Murthy
Shri G. Venkataraman
Dr. S. Ramamurthy
Dr. M.J. George
Shri K.V. Narayana Rao
Shri T. Jacob
Dr. M.D.K. Kuthalingam
Dr. (Mrs.) P.V. Kagwade
Shri M.S. Muthu
Shri S. Mahadevan
Dr. K. Radhakrishna
Dr. M.M. Thomas
Shri D. Sadananda Rao
Shri K. Rangarajan
Dr. V.S. Krishnamurthy Chennubhotla
Shri M.H. Dhulkhed
Dr. K.C. George
Shri G. Subbaraju
Dr. G. Luther
Shri M.S. Rajagopalan
Shri A. Noble
Dr. M. Vasudev Pai
Shri V. Balan
Dr. K. Satyanarayana Rao
Shri K.A. Narasimham
Shri M. Kumaran
Shri P.T. Meenakshisundaram
Dr. P. Vijayaraghavan
Shri K.N. Krishna Kartha
Dr. C.S. Gopinatha Pillai
Dr. K. Alagaraja
Shri S.K. Dharmaraja

Scientist S-2 (Rs. 1100-1600)

Shri M. Mydeen Kunju
Shri C.P. Ramamirtham
Shri P. Bensam
Shri V.M. Deshmukh
Shri V.N. Bande
Shri C. Mukundan
Shri G.G. Annigeri
Shri R. Marichamy
Dr. T. Appa Rao

Dr. R.S. Lalmohan
Shri D.C.V. Easterson
Shri P. Sam Bennet
Shri R. Reuben
Dr. P. Parameswaran Pillai
Dr. P.S. Kuriakose
Dr. A.D. Diwan
Dr. R. Paul Raj
Shri D.B.S. Sehara
Shri N.S. Radhakrishnan
Shri J.C. Gnanamuthu
Shri N. Neelakanta Pillai
Shri Kuber Vidyasagar
Shri G. Sudhakara Rao
Dr. P.A. Thomas
Dr. D.B. James
Shri C. Suseelan
Shri Kunjukrishna Pillai
Shri C.P. Gopinathan
Shri K.J. Mathew
Dr. M.K. George
Shri K.M.S. Ameer Hamsa
Shri R. Sarvesan
Dr. P. Devadoss
Dr. V. Sriramachandra Murthy
Shri G.S. Daniel Selvara
Shri K.K. Appukuttan
Shri S. Lazarus
Shri M. Kathirvel
Shri K. Rengarajan
Shri Y. Appannasastry
Shri A. Chellam
Shri E.V. Radhakrishnan
Dr. E. Vivekanandan
Shri M. Rajamani
Shri C. Muthiah
Shri P. Muthiah
Shri Madan Mohan
Shri G. Mohanraj
Dr. S. Kulasekhara Pandian
Shri G. Gopakumar
Smt. Mary K. Manisseri
Shri G. Syda Rao
Dr. A. Laxminarayana
Shri M. Vijayakumaran
Dr. L. Krishnan
Dr. (Smt.) S. Lalitha Devi
Shri A.R. Thirunavukkarasu
Dr. H. Mohamed Kasim
Shri K.G. Girijavallabhan
Dr. N. Gopalakrishna Pillai
Dr. A.G. Ponniah
Shri V. Gandhi
Shri A. Raju
Shri K. Devarajan
Shri K.V. Somasekharan Nair
Shri T.M. Yohannan
Shri A.C.C. Victor
Shri K.K. Sukumaran
Shri P. Nammalwar
Shri K. Prabhakaran Nair
Shri A.A. Jayaprakash
Shri G. Nandakumar
Shri K. Ramadoss
Dr. N. Gopinatha Menon
Shri Pon Siraimeetan
Shri P.N. Radhakrishnan Nair
Dr. N. Kaliaperumal
Mrs. Rany Mary Jacob
Shri K.N. Rajan
Dr. (Mrs.) S. Sivakami
Shri K.S. Scariah
Shri R. Thiagarajan
Shri M. Rajagopalan
Shri M.E. Rajapandian
Smt. V. Chandrika
Shri S. Dharmaraj
Shri K. Narayana Kurup
Shri M. Srinath
Shri K.K.P. Panikkar
Shri R. Sathiadas
Shri Syed Ahamadali

Scientist S-1 (Rs. 700-1300)

Shri N. Surendranatha Kurup
Shri G.P. Kumaraswamy Achary
Shri K.Y. Telang
Shri Alexandar Kurian
Shri P.V. Sreenivasan
Miss R. Padmini
Mrs. Gracy Mathew
Shri V. Thangaraj Subramanian
Dr. V.S. Kakati
Dr. N. Ramachandran
Shri S.K. Chakraborthy
Shri Vinay D. Deshmukh

Mrs. Geetha Bharathan
Shri K.S. Sundaram
Shri A. Reghunathan
Shri P. Livingston
Shri S. Shanmugham
Shri K.R. Manmadan Nair
Shri S. Krishna Pillai
Shri P.E. Sampson Manikam
Shri D. Sivalingam
Shri M.M. Meiyappan
Shri P. Natarajan
Shri Mohamed Zafar Khan
Shri T.S. Velayudhan
Shri G. Radhakrishnan
Shri V.S. Rengaswamy
Shri I. David Raj
Shri S. Sreenivasa Rengan
Shri K. Balan
Smt. Krishna Srinath
Shri S. Muthusamy
Shri D. Kandasami
Shri M. Aravindakshan
Smt. T.S. Naomi
Shri C.V. Mathew
Shri G.M. Kulkarni
Smt. K. Vijayalakshmi
Shri P. Karuppusamy

LIST OF TECHNICAL PERSONNEL

(Not a gradation list)

Field Officer (T-7) (Rs. 1100-1600)

Shri C.R. Shanmughavelu
Shri Syed Basheeruddin
Shri S.S. Dan
Shri J.P. Karbari

Field Officer (T-6) (Rs. 700-1300)

Shri G. Balakrishnan
Shri S. Natarajan
Shri U.K. Sathyavan
Shri R.V. Singh

Curator (T-5) (Rs. 650-1200)

Shri A. Bastian Fernando

Senior Technical Assistant (T-5) (Rs. 650-1200)

Shri Varughese Philipose
Shri T. Prabhakaran Nair
Shri W. Venugopalan

Senior Technical Assistant (T-4) (Rs. 550-900)

Shri K. Ramachandran Nair
Shri A.C. Sekhar
Shri P.S. Sadasiva Sarma
Shri P.K. Mahadevan Pillai
Shri K. Ramakrishnan Nair
Shri R. Bhaskaran Achari
Shri N. Ratnasami
Shri K.C. Yohanan
Shri K. Nandakumaran
Shri M. Ayyappan Pillai
Shri M. Badruddin
Shri V.K. Balachandran
Shri C.V. Seshagiri Rao
Shri S. Kalimuthu
Shri K.N. Gopalakrishnan
Shri S.B. Chandrangathan
Shri M.V. Somaraju
Shri S. Kandasamy
Shri G. Gurusamy
Shri M. Babu Philip
Shri M. Mohamed Sultan
Shri Jacob Jerold Joel
Shri S.G. Vincent
Shri P.M. Aboobaker
Shri E.K. Raveendran (on deputation to A & N Admn.)
Shri C.G. Lakshmah
Shri R. Reghu
Shri P. Karunakaran Nair
Shri A. Agastheesapillai Mudaliar
Shri K.K. Balasubramanian
Shri K.V.S. Seshagiri Rao

Technical Assistant (T-II-3) (Rs. 425-700)

Shri T. Girijavallabhan
Shri A.A. Thankappan
Shri N.P. Kunhikrishnan
Shri P. Ananda Rao

Shri T.G. Vijaya Warrier
Shri A. Hanumantha Rao
Shri I.P. Ebenizer
Shri C.K. Krishnan
Shri K.S. Krishnan
Smt. K. Kamumudi Menon
Shri P. Ramadas
Shri C.T. Rajan
Smt. S. Lakshmi
Shri S. Manivasagam
Shri K.K. Kunhikoya
Shri V. Suresh
Shri K. Soman
Shri M. Shriram
Shri S.K. Balakumar
Smt. C. Nalini
Shri R. Vasanthakumar
Shri P. Ramalingam
Smt. Abha Kant
Smt. Geetha Antony
Shri B. Narayana Rao
Shri K. Thulasidoss
Shri T.S. Balasubramanian

Technical Assistant (T.1.3) (Rs. 425-700)

Shri S. Siddalingaiah
Shri A. Ganapathi
Shri C. Kasinathan
Shri J.R. Ramalingam
Shri M. Najumuddin
Shri K.B. Wagmare
Shri Y.D. Savaria
Shri G. Subramanya Bhat
Shri Joseph Xavier Rodrigo
Shri K. Ramasomyajulu
Dr. C. Thankappan Pillai
Shri Joseph Andrews
Shri K. Chittibabu
Dr. N. Jayabalan
Shri K. Dhanaraju
Shri V.A. Narayanankutty
Shri K. Muniyandi
Shri Z. Jayasankaran
Shri N. Sundaram (now on other duty as Adm. Officer, CIGR, Mathura, U.P.)
Shri K. Balachandran
Smt. A. Kanagam
Shri D. Sundrarajan
Shri D. Vincent
Shri K.P. Viswanathan
Shri V. Sivasami
Shri N. Palaniswamy
Shri T. Chandrasekhara Rao
Shri L. Chidambaram
Smt. Alli C. Gupta
Shri O.M.M.J. Habeeb Mohamed
Shri M. Selvaraj
Shri R. Thangavelu
Shri A. Srinivasan
Shri V. Thanapathi
Shri H. Kather Batcha
Shri S. Palanichamy
Smt. Uma S. Bhat
Shri Sapan Kumar Ghosh
Shri S. Subramani
Shri M. Manicharaja
Shri A. Devendra Gandhi
Shri M.D. Arputha Raj
Shri Hameed Batcha
Shri V. Rangacharyalu

Jr. Technical Assistant (T-2) (Rs. 330-560)

Shri J.L.Oza
Shri K. Muthiah
Shri K. Ramadas Gandhi
Shri T. Krishnan kutty
Shri K. Chellappan
Smt. K.K. Valsala
Shri K. Chandran
Shri Mathew Joseph
Shri M.N. Kesavan Eleyathu
Shri K.K. Surendran
Miss T.A. Omana
Shri K. Narayana Rao
Shri M. Chandrasekharan
Shri C.S. Sasidharan
Shri V. Achutha Rao
Shri C. Manimaran
Shri N. Vaithianathan
Shri G. Arumugham
Shri S. Rajapackiam
Smt. P. Swarnalatha
Shri G. Srinivasan
Shri R. Soman
Shri M. Radhakrishnan

Shri M. Chellappa
Shri A. Ramakrishnan
Shri T. Dhandapani
Shri M. Bose
Smt. V.K. Janaki
Shri V.G. Surendranathan
Shri M.P. Sivadasan
Shri J. Narayana Swami
Shri K.T. Thomas
Shri S. Sathya Rao
Shri A.K. Velayudhan
Shri P. Poovannan
Shri P. Venkatakrishna Rao
Shri A. Prosper
Shri C.J. Josekutty
Shri K. Srinivasagam
Shri K. Sahul Hameed
Shri H. Ramachandra
Shri C.K. Dinesh
Shri S. Hanumantharaya
Shri B. Sridhara
Shri D. Nagaraja
Shri J. Bhavaneshwara Varma
Shri C.H. Ellithathayya
Shri H.K. Dhokia
Shri B.P. Thumber
Shri S. Chandrasekhar

Field Assistant (T-1) (Rs. 260-430)

Shri M. Manivasagam
Shri S. Sankaralingam
Shri P. Palani
Shri S. Kemparaju
Shri Pulin Behari Dey
Shri A. Ahamed Kamal Basha
Shri S.S. Sugawekar
Shri Padmasekhara
Shri N. Chennappa Gowda
Shri R. Dias Johny
Shri L. Venkatachalamoorthi
Shri A.Y. Mestry
Shri H.S. Shivahna
Shri O. Tippaisamy
Shri D.G. Jadhav
Shri L.R. Khambadkar
Shri V.S. Gopal
Shri M.S. Sumithrudu
Shri A.D. Sawant
Shri P. Thirumilu
Shri S. Mohan
Shri H.S. Mahadevaswamy
Shri R. Subramanian
Shri P. Thillairajan
Shri B.B. Chavan
Shri M. Enose
Shri N. Varatharajan
Shri M.G. Sivadasan
Shri A. Kumar
Shri Maruti S. Sankar Naik
Shri M.B. Vallabh
Shri Sukudev Bar
Shri R.G. Kumulkar
Shri M. Abdul Nizar
Shri A. Nandakumar
Mrs. Lalitha Sekharan
Shri Y. Muniappa
Shri M. Prasade Rao
Shri J.D. Sarang
Shri S.D. Kamble
Shri B.N. Kakkar
Shri Devidas Y. Naik
Shri T.B. Harikartsh
Shri Mongal Singh Suraj Singh Sula

Senior Technical Assistant (T-4) (Computors) (Rs. 550-900)

Shri Varghese Jacob
Shri G. Krishnankutty Nair
Shri P. Sivaraman
Shri V. Rajendran
Smt. V.P. Annam

Computor (T-I.3) (Rs. 425-700)

Shri A. Kanakkan
Shri S. Haja Najeemuddin
Shri C.J. Prasad
Smt. P.L. Ammini

Punch Card Operator (T-1) (Rs. 260-430)

Shri K.P. George
Shri M.B. Seynudeen
Shri P.P. Pavithran
Kum. M.R. Beena

Smt. P.T. Mani
Shri M. Ramachandran
Shri K. Anandan
Smt. Latha Govindraw Thote

Motor Driver (T.I.3) (Rs. 425-700)

Shri K. Karuppiak
Shri K.P. Velu
Shri P. Krishnan

Motor Driver (T-2) (Rs. 330-560)

Shri O. Muthukaruppan
Shri G. Natarajan
Shri C.D. Davis
Shri V. Varadaiah
Shri K. Dharma Rao
Shri K. Ratnakumar
Shri M. Gopinathan Nair
Shri S. Yadavayya

Motor Driver (T-1) (Rs. 260-430)

Shri P. Pasupathi Rao
Shri K.K. Soman
Shri K.J. Mathew
Shri C.S. Xavier
Shri S. Ramachandran Nair
Shri Govind Nath Chudasama
Shri Xavier Mohandas
Shri K. Alagirisamy
Shri K. Ramakurup
Shri K. Narayanan Nair
Shri M.N. Appukuttan Nair

Sr. Library-cum-Documentation Assistant (T-5) (Rs. 650-1200)

Shri K. Kanakasabapathi

Sr. Library Assistant (T-4) (Rs. 550-900)

Shri E. Johnson

Library Assistant (T.I.3) (Rs. 425-700)

Smt. Girijakumari
Shri V. Edvin Joseph

Driver (Boat) (T.I.3) (Rs. 425-700)

Shri M. Mustaffa
Shri A. Pathrose
Shri S.G. Kalgutkar

Driver (Boat) (T-2) (Rs. 330-560)

Shri M.A. Vincent
Shri M. Mohideen Abdul Kader

Driver (Boat) (T-1) (Rs. 260-430)

Shri D. Padmanabhan
Shri James George

Serang (T.I.3) (Rs. 425-700)

Shri C.K. Dhandapani
Shri O.M. Jainulabdeen

Serang (T-1) Rs. 260-430)

Shri H. Vasu

Bosun (T.II.3) (Rs. 425-700)

Shri P. Herozhkhan
Shri T.E. George Augustine
Shri Thomas Teles
Shri Nirmal Mathews

Senior Artist (T-4) (Rs. 550-900)

Shri K.L.K. Kesavan

Artist (T.I.3) (Rs. 425-700)

Shri A. Muniyandi

Artist (T-1) Rs. 250-430)

Shri K.K. Sankaran

Photographer (T-5) (Rs. 650-1200)

Shri P. Raghavan

Mechanic (T-1) (Rs. 260-430)

Shri M. Alagar

Painter-cum-polisher (T.I.3) Rs. 425-700)

Shri R. Marimuthu

Cook (Boat) (T-2) (Rs. 330-560)

Shri A.K. Unnikrishnan

Shri K.K. Prabhakaran
Shri E. Sivanandan

Cook (Boat) (T-1) (Rs. 260-430)

Shri M. Rengan
Shri Vali Mohamed
Shri Yerinindra Rao
Shri K.C. Gopalan

Carpenter (T-1) (Rs. 260-430)

Shri T.P. Haridasan

Skin Driver (T-I-3) (Rs. 425-700)

Shri J. Antony Pitchai
Shri A. Dasman Fernando
Shri F. Soosai V. Rayan

Hindi Translator (T-4) (Rs. 550-900)

Miss. A. Rajeswari Menon

Project Operator (T-1) (Rs. 260-430)

Shri K. Chacko

Deckhand (T-2) (Rs. 330-560)

Shri M.K. Gopalakrishnan
Shri K.S. Leon
Shri V. Vedanayagam
Shri P. Munisamy

Deckhand (T-1) (Rs. 260-430)

Shri M. Ibrahim
Shri D. Bosco Fernando
Shri D. Anandan
Shri S. Enasteen
Shri R. Arokiaswamy
Shri K. Parasuraman
Shri C. Manibal
Shri S. Kesavan
Shri S. Ganesan
Shri P.M.D. Abdul Moheeder
Shri R. Sekar
Shri U. Alagamalai
Shri K.C. Devassy
Shri P.M. Hariharan
Shri V.B. Benziger
Shri P. Hillary

Skipper (T-7) (1100-1600)

Shri P.R. Leopold

Chief Engineer (T-6) (Rs. 700-1300)

Shri P.J. Joshy Jacob

Mate (T-6) (Rs 700-1300)

Shri P.K. Velayudhan

Bosun (T-4) (Rs. 550-900)

Shri B. Ramesh

Engine Driver (T.II.3) (Rs. 425-700)

Shri Johnson K. Kuriakose

Deckhand Sr. (T.2) (Rs. 330-560)

Shri P. Bhaskaran
Shri T.K. Sudhakaran
Shri S. Moideen Meerasa
Shri V. Maria Alwaris
Shri K.P. Vijayan

Oilman (T-2) (Rs. 330-560)

Shri T.R. Sreekumaran

Oilman-cum-Deckhand (T-2) (Rs. 330-560)

Shri P.D. Chidambaram
Shri L. Jobai Fernando

Foreman (T.II.3) (Rs. 425-700)

Shri P. Thankappan

Technical Officer (T.7) - CAS (Rs. 1100-1600)

Shri K.V. George

Farm Engineer (T-7) - CAS (Rs. 1100-1600)

Shri B.S. Ramachandrudu

Krishi Vigyan Kendra, Narakkal.

Senior Training Assistant (T-6) (Rs. 700-1300)

Shri P. Karunakaran Nair
Shri K. Ashokakumaran Unnithan

Dr. P.K. Martin Thompson
Shri K.N. Rasachandra Kartha

Training Assistant (T-5) (Rs. 650-1200)

Shri A.N. Mohanan
Shri P. Radhakrishnan

Bosun (T-II-3) (Rs. 525-700)

Shri N.B. Gopalakrishna Menon

Driver (Boat) (T-1) (Rs. 260-430)

Shri K.K. Bose

Cook (Boat) (T-1) (Rs. 260-430)

Shri K. Raju

Operational Research Project, Kovalam

Technical Assistant (T.I.3) (Rs. 425-700)

Shri V. Selvaraj

Motor Driver (T-2) (Rs. 330-560)

Shri K. Pandi

Administrative Staff as on 31-3-1984.

Administrative Officer

Shri V.K. Sridhar

Asst. Administrative Officer

Shri K. Dorairaj

Asst. Accounts Officer

Shri M.P. Chandrasekharan

Superintendents

Shri S.P.L. Sethu
Shri S. Subramanian
Shri M.P. Lakshmanan
Shri A. Sethubhaskaran
Shri P. Aithappa Naik
Shri M. Subbiah
Shri G.V. Padnekar
Shri A.K. Balakrishna Pillai
Shri S.R. Narayanan

P. A to Director

Shri L. Krishnaswamy
Shri K.M. Surendran